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* SERVICE MANUAL *
TNC 370

Changes/Developments
We are constantly working on technical improvements of our products.
For this reason, details described in this manual may differ slightly from your control. In this case, please order a revised service manual from us.

Duplication
This manual is provided subject to the condition that no part of it shall be duplicated in any form without our prior consent.

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1. How to Use this Service Manual

The service manual TNC 370 can be used to diagnose, locate and eliminate errors on machine tools controlled by TNC.

In order to correctly judge the problems in an NC-controlled machine tool, fundamental knowledge of the machine tool and its drives as well as their interaction with the control and the measuring systems is required. Incorrect behaviour of the machine tool can also result from improper use of the control, NC-programming errors and incorrect or not properly optimized machine parameters.

For further information in this respect please refer to the

- **Documentation of the machine tool manufacturer**
- **Operating Manual** (HEIDENHAIN)
- **Technical Manual** (HEIDENHAIN).

The Technical Manual is not enclosed with every control. In general, it is only supplied to the machine tool manufacturer and is updated by HEIDENHAIN, Traunreut. Therefore, it is absolutely necessary to contact the machine tool manufacturer, if errors occur that are due to a machine parameter or to the interface of the control. Support will however also be provided by the HEIDENHAIN service department and agencies. Telephone numbers, addresses and telex/fax numbers can be found on the back side of the cover page and the back side of the service manual.

2. Minor Error Messages

TNC 370 features a comprehensive integral monitoring system to avoid input and operation errors, to locate errors and technical defects of the entire equipment (TNC, measuring systems, machine tool, cables etc.). The monitoring system is a fixed component of the TNC hardware and software; it is always active when the control is switched on. If a technical defect or an operation error is detected, an error message in plain language is displayed on the screen.

To clear **minor error messages**, press CE.

Further error messages are described in the

- **Operating Manual TNC 370**
- **Technical Manual TNC 370**
- **Documentation by the machine tool manufacturer** or in the
- **Operating Instructions FE 401 B**.

Error Message	Section
AXIS DOUBLE PROGRAMMED	15.2
START POSITION INCORRECT	15.2
TOUCH POINT INACCESSIBLE	15.2
RANGE EXCEEDED	15.2
OPERATING PARAMETERS ERASED	2.1
FILE NAME NOT PROGRAM NAME	16.3
FAULTY RANGE DATA	15.2
ROTATION NOT PERMITTED	15.2
DATA MEDIUM MISSING	16.3
DATA MEDIUM EMPTY	16.3
DATA MEDIUM WRITE-PROTECTED	16.3
LIMIT SWITCH <AXIS>	2.1
PLANE WRONGLY DEFINED	15.2
ENTRY VALUE INCORRECT	16.3
EMERGENCY STOP	19.5
EXT. IN-/OUTPUT NOT READY	16.3
ERR: 001 TO ERR: 109	16.3
WRONG OPERATING MODE	16.3
WRONG AXIS PROGRAMMED	15.2
PROGRAM DATA ERRONEOUS	16.3
PROTECTED FILE	16.3
HANDWHEEL ?	14.3

Error Message	Section
HANDWHEEL DEFECTIVE	14.3
HANDWHEEL NOT READY X	14.3
ILLEGAL COMMAND	16.3
ME: TAPE END	16.3
PLC PROGRAM NOT TRANSLATED	2.1
PLC: ERROR <00 to 99>	2.1
POSITIONING ERROR	2.1
PROGRAM INCOMPLETE	16.3
PROGRAM NOT AVAILABLE	16.3
MIRRORING NOT PERMITTED	15.2
POWER INTERRUPTED	2.1
RELAY EXT. DC VOLTAGE MISSING	19.5
ILLEGAL SEARCH ADDRESS	16.3
STYLUS ALREADY IN CONTACT	15.2
PROBE SYSTEM NOT READY	15.2
EXCHANGE TOUCH PROBE BATTERY	15.2
TRANSFERRED VALUE ERRONEOUS X	16.3
TRANSFERRED DATA INCORRECT X	16.3
DATUM SHIFT NOT PERMITTED	15.2
TIME LIMIT EXCEEDED	15.2

2.1 Causes of Minor Error Messages

OPERATING PARAMETERS ERASED

- With new and exchange controls, the machine parameters are always erased.
- Defective buffer batteries, accumulator or capacitor
- RAM error on the processor board
- RAM data are always erased after a software exchange

LIMIT SWITCH <AXIS>

- "Manual" Operating Mode
  The preset **software limit** switch has been reached during traverse with the directional keys.
- "Automatic" Operating Mode
  The **calculated position** of the current block is **beyond** the **software limit switch range** or **beyond** the **additional limit** (set with the MOD function <AXIS LIMIT>).
  The positioning is not performed.

Machine Parameters for the Software Limit Switches

	X+	X-	Y+	Y-	Z+	Z-
Default setting	910.0	920.0	910.1	920.1	910.2	920.2
Activation via PLC [1]	911.0	921.0	911.1	921.1	911.2	921.2
Activation via PLC [1]	912.0	922.0	912.1	922.1	912.2	922.2

	IV+	IV-	V+	V-
Default setting	910.3	920.3	910.4	920.4
Activation via PLC [1]	911.3	921.3	911.4	921.4
Activation via PLC [1]	912.3	922.3	912.4	922.4

[1] PLC markers M 2816 and M 2817

POWER INTERRUPTED

- After a reset signal of the power supply (e.g. line voltage drops).
- Important machine parameters may have been changed (e.g. MP 110.X, MP 210).
- This message is generated during every power-on routine (see section 19.6).

POSITIONING ERROR

- The servo lag monitor set in the machine parameters 1410 or 1710 has responded.
  (Check the run-in behaviour of the axis; readjust, if necessary.)

PLC PROGRAM NOT TRANSLATED

- After editing, the PLC program must be compiled (translated) anew.

PLC: ERROR 00	marker	2924	— set
to	to		
PLC: ERROR 99	marker	3023	

- Instead of PLC: ERROR 00 to 99 another dialog may be displayed with customized PLC programs.
  For further information please contact your machine tool manufacturer.

3. Major Error Messages and Their Causes

The integrated monitoring system distinguishes between minor and gross errors. Gross errors are characterized by a **blinking display** (e.g. malfunctions of the encoders, of the drives and data processing errors).
If a gross error occurs, the control opens the contact **"Control Ready for Operation"** causing an emergency stop of the machine tool.

By switching off the main switch or by pressing

, the emergency stop state can be reset, provided that the error cause has been eliminated.

Blinking display	Error cause
PROCESSOR CHECK ERROR X	X = 0 CRC sum control data incorrect D0.w = CRC sum ,A2.L = memory address D1.w = CRC sum, if error message generated by CRCEIN. 1 CRC sum machine parameters incorrect D0.w = CRC sum ,A2.L = memory address D1.w = CRC sum, if error message generated by CRCEIN. 2 Check sum NC-memory incorrect 3 Test plane incompletely / will not run 4 Crosstalk between data bits in RAM 5 Crosstalk between addresses in RAM 6 Stack overflow A1.L = bounce pulse address (8421) 7 CRC sum PLC program ASCII 8 CRC sum PLC program OP-Code 9 CRC sum test section A Software error B Wrong interrupt Differentiation with register V0: 08 bus error 0C address error 10 illegal instruction 14 division by 0 18 error output for CHK command (check range) 20 error output for TRAPV command (trap on overflow) 24 privilege infringement (supervisor command in the user mode) 28 emulator trap 2C emulator trap 30 - 34 - 38 - 3C interrupt vector not initialized 40 interrupt vector not initialized 44 interrupt vector not initialized 48 interrupt vector not initialized 4C - 50 -

Blinking display	Error cause
PROCESSOR CHECK ERROR X (continued)	X = (Register V0 continued) 54 - 58 - 5C - 60 false interrupt (with priority 0) 64-7C interrupt auto-vector 4-7, user interrupt $100-$3FC 94-BC TRAP #5 - #15 C PLC load has reached 300% D Command stack overflow control loop E Wrong command main proc. → control loop F Wrong display mode main proc.→ display H Control loop "counter not latched" L Wrong command control loop M Operating voltage out of tolerance P Inhibited software function activated (function without software enable module) R The control tried to start a PLC positioning, a datum shift, an oriented spindle stop or to switch the range although M7440/bit2=1 (continuous with M output) or MP3030 (continuous with S output).

If the error messages **PROCESSOR CHECK ERROR XY** (XY = code; see above) comes up repeatedly, send the **complete logic unit** to HEIDENHAIN for repair. Please indicate the **error message and the code.**

Blinking display	Error cause		
ERROR IN PLC PROGRAM XX	XX = 1A	NC start	complement missing
	1B	Rapid traverse	complement missing
	1C	Directional key latch	complement missing
	1D	Feed rate enable	complement missing
	1E	PLC pos. X	complement missing
	1F	PLC pos. Y	complement missing
	1G	PLC pos. Z	complement missing
	1H	PLC pos. IV	complement missing
	1I	Directional key X+	complement missing
	1J	Directional key X-	complement missing
	1K	Directional key Y+	complement missing
	1L	Directional key Y-	complement missing
	1M	Directional key Z+	complement missing
	1N	Directional key Z-	complement missing
	1O	Directional key IV+	complement missing
	1P	Directional key IV-	complement missing
	1Q	More than one of the markers M2485...M2487 (M03, M04, M05) are set simultaneously	
	2A	Jog increment pos. X+	complement missing
	2B	Jog increment pos. X-	complement missing
	2C	Jog increment pos. Y+	complement missing
	2D	Jog increment pos. Y-	complement missing
	2E	Jog increment pos. Z+	complement missing
	2F	Jog increment pos. Z-	complement missing
	2G	Jog increment pos. IV+	complement missing
	2H	Jog increment pos. IV-	complement missing

Display	Error cause	
ERROR IN PLC PROGRAM X	X = 0	Not a valid command
	1	Operand for jump is no label (can only be generated when reading in data over the interface. In a jump command the type of the operand is indicated.)
	2	Invalid operand type (the command must not be combined with this operand).
	4	Operand beyond the permissible range (the value is too high or odd address with word and double-word.)
	5	No limiter after command (can only be generated when reading in data over the interface. The comment after the command was not marked by ";" or "*").
	6	No end of line found (can only be generated when reading in data over the interface; comment too long.)
	7	Called label not defined
	8	No end-program condition found (the program does not contain an EM instruction, or it contains a JP instruction without a LBL instruction following.)
	9	Program is too long (RAM overflow) (insufficient memory for the program code to be generated.)
ERROR IN PLC PROGRAM XX	XX = 10	Assign with parenthesis (an =, S, SN, R, RN or PS instruction has been programmed, although arithmetic parenthesis are open)
	11	Excessive nesting of parentheses (more than 16 parentheses are open)
	12	Jump within a gating sequence (unconditional jump has been programmed, although the gating sequence was not closed with an Assign)
	13	"Close Parenthesis" without "Open Parenthesis" (a "Close Parenthesis" command was programmed, although no parentheses were open)
	14	Label within parentheses (a LBL instruction has been programmed, although parentheses are open)
	15	Label within a gating sequence (a LBL instruction has been programmed, although the previous gating was not closed with an Assign)
	16	Jump within parentheses (a jump instruction has been programmed, although parentheses are open)
	17	Parentheses open at the end of a block (an EM instruction has been programmed, although parentheses are open)
	18	Label defined twice
	19	Word Assign missing (a Logic instruction or gating has been programmed, although the previous Word gating was not closed with a Assign)
	20	Logic Assign missing (a Word instruction has been programmed, although the previous Logic-gating was not closed with an Assign)

Display	Error cause
ERROR IN PLC PROGRAM XX (continued)	21 Word accumulator not loaded (a Word Assign or gating has been programmed, although the Logic accumulator does not contain a definite value) 22 Logic accumulator not loaded (a Logic has been programmed, although the Logic accumulator does not contain a definite value) 23 Accumulators not loaded on "Open Parentheses" (an A[, AN[, O[, ON[, XON[command has been programmed, although neither the word nor the logic accumulator has been gated or loaded) 24 Incorrect type of parentheses result (a different type has been calculated in the parentheses from that which was defined in the "Open Parentheses" command, i.e. logic instead of word or vice versa) 25 Conditional jump with invalid logic accumulator (a conditional jump has been programmed, although the logic accumulator does not contain a definite value) 26 Empty CASE instruction 27 "END-CASE" missing 53 PLC load has reached 150% (time out)
ERROR IN PLC PROGRAM XX	50 Excessive nesting (too many modules nested inside one another) 51 Stack underflow (an attempt to acquire data from the STACK, although it was empty.) 52 Stack overflow (an attempt to load too many data onto the STACK.) 54 CASE arguments are larger than the number of entries in the table. 58 A major error has occurred while a PLC module was being called.

NOTES

Blinking display	Error cause
GROSS POSITIONING ERROR <AXIS> A	**Positioning (Servo Lag) Monitoring** • **Operation with feed-forward control:** position monitoring range exceeded (range defined in MP1420) • **Operation with servo lag:** servo lag monitoring range exceeded (range defined in MP1720)
GROSS POSITIONING ERROR <AXIS> B	**Monitoring of the Analogue Voltage Limit** • The nominal voltage calculated by the control has reached its limit of ± 10 V (± 20 V for spindle). (only with feed forward control)
GROSS POSITIONING ERROR <AXIS> C	**Movement Monitoring** • The path actually traversed in a certain time is less than ¼ of or more than 4x the nominal value calculated by the control. (can be influenced via MP1140)
GROSS POSITIONING ERROR <AXIS> D	**Standstill Monitoring** • The deviation from the nominal position of an axis in standstill has exceeded the value programmed in the machine parameter MP1110.
GROSS POSITIONING ERROR <AXIS> E	**Monitoring of the Offset Voltage** • The offset voltage limit of 100mV has been reached during an automatic offset adjustment with MP1220.

Error Location

When the error message GROSS POSITIONING ERROR is displayed, the error may be located in any element of the closed loop.

e.g.
- Error in control (e.g. CLP board)
- Excessive offset voltage at the servo amplifier
- Incorrect speed adjustment at the servo amplifier
- Monitoring function of servo amplifier has responded (e.g. monitoring of current intensity)
- Electrical defect at the servo amplifier
- Mechanical error (bearing, spindle, guides)
- Excessive mechanical forces on a drive

Blinking display	Error cause
ENCODER <AXIS> DEFECTIVE A	Signal amplitude error
ENCODER <AXIS> DEFECTIVE B	Signal frequency error
ENCODER <AXIS> DEFECTIVE C	Error with distance-coded scales **Error causes:** • Encoder not connected • Cable damaged • Glass scale contaminated or damaged • Scanning head defective • Encoder monitoring system defective Checking the encoders: see section 13
WRONG REFERENCE POINT	Wrong reference mark spacing entered with distance-coded linear encoders (counting error caused by the measuring system or the logic unit.)
TNC OPERATING TEMP. EXCEEDED	The temperature inside the logic unit has exceeded + 70°C.
EMERGENCY STOP DEFECTIVE	Error during the test routine for the output "control ready for operation" after power-on.
EMERGENCY STOP PLC	This error message is only generated, if the marker 2815 is set without additional marker (M2924 - M3023).
RELAY EXT. DC VOLTAGE MISSING	No PLC supply voltage at connector X44.

Notes

Blinking display		Error cause		
PLC: Error 00	1)	marker	2924	— **and** marker 2815 set
to		to		
PLC: Error 99	1)	marker	3023	
CHECK SUM ERROR YX		1A	CRC sum	NC EPROM 1/2 incorrect
		1B	CRC sum	PC EPROM incorrect
			A2.L = address CRC sum	
			D0.W = calculated CRC sum	

[1] Instead of PLC: ERROR 00 ... 99 another dialogue may be displayed with customized PLC programs. For further information, please contact your machine tool manufacturer.

CRC = Cyclic Redundancy Check (during data transfer)

If the error message **CHECK SUM ERROR YX** comes up repeatedly, send the **complete logic unit** to HEIDENHAIN for repair. Please indicate the **check sum error**.

Notes

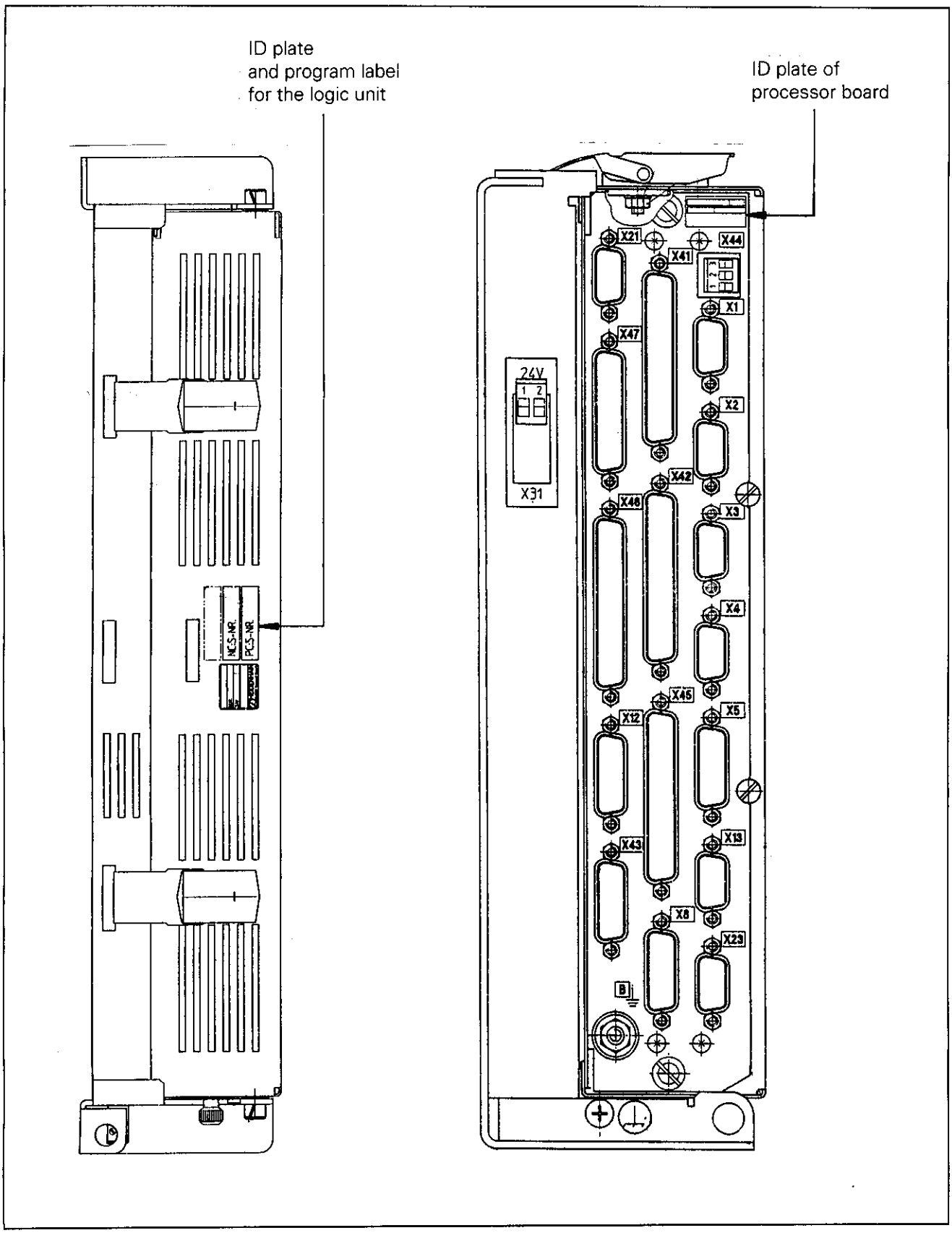
4. Hardware Components TNC 370

Component \ TNC	TNC 370
LOGIC UNIT LE 370	
Id.No. 288 711 –	x
VISUAL DISPLAY UNIT BF 370/371	
Id.No. 288 708 01 (BF 370)	x
Id.No. 288 708 02 (BF 371)	x
KEYBOARD UNIT TE 370/371	
Id.No. 288 713 – (TE 370)	x
Id.No. 293 420 01 (TE 371)	x
PLC I/O BOARD PL 405B (Option) [1]	
Id.No. 263 371 22	x
PLC I/O BOARD PL 410B (Option)	
Id.No. 263 371 02 [2] [4]	x
Id.No. 263 371 12 [3]	

1) only digital part (32 PLC inputs / 16 PLC outputs)
2) 64 PLC inputs / 32 PLC outputs and analogue part
3) 64 PLC inputs / 32 PLC outputs, no analogue part
4) the analogue part of PL 410B is evaluated by TNC 370!

5. LOGIC UNIT LE 370

5.1 Designation of the Logic Unit LE 370



5.2 Hardware Components of the LOGIC UNIT LE 370

Board Overview TNC 370

	TNC 370			
	LE 370 288 711 1-	**LE 370 288 711 2-**	**LE 370 288 711 3-**	**LE 370 288 711 4-**
Processor Board				
287 382 01	x			
289 454 01		x		
290 115 01			x	
290 115 02				x
Power Supply Board				
236 484 10	x	x	x	x

6. Connector Designation and Pin Layout

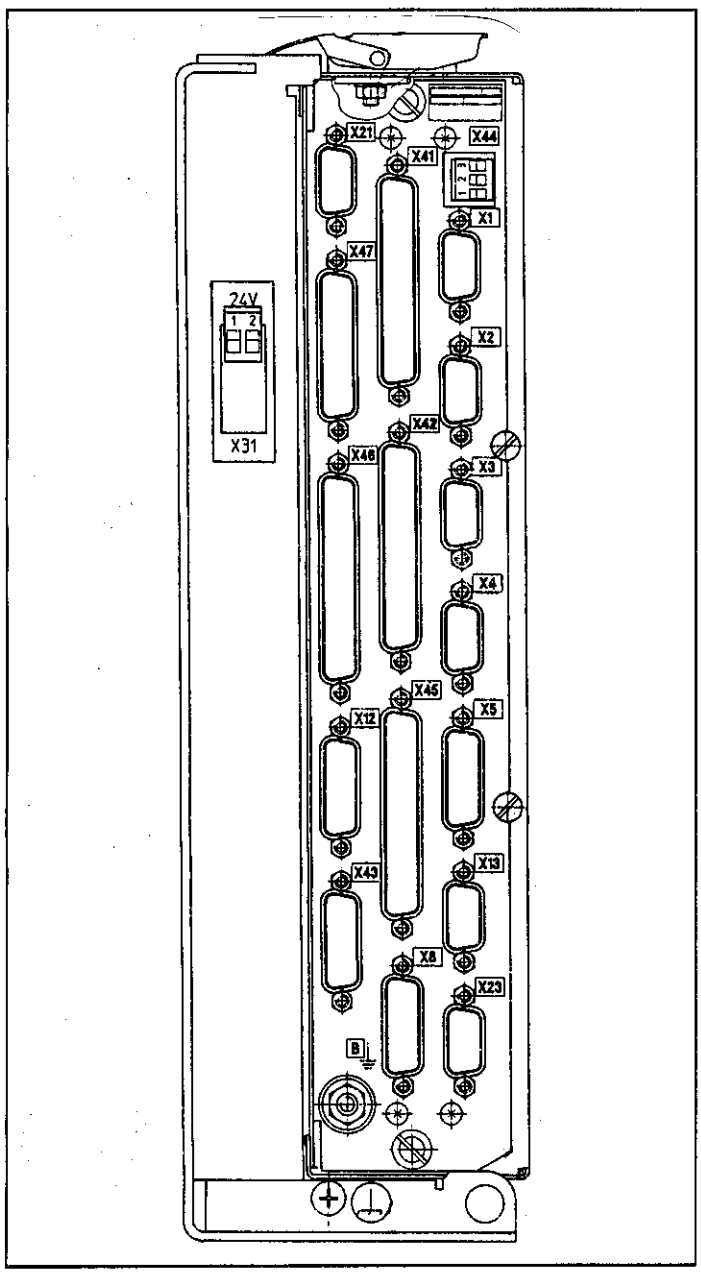
6.1 Connectors on the Logic Unit LE 370

6.1.1 Connector Designation LOGIC UNIT LE 370

LE 370

Power supply

Processor board



Processor board

X1 = Measuring system 1 (~)
X2 = Measuring system 2 (~)
X3 = Measuring system 3 (~)
X4 = Measuring system 4 (~)
X6 = Measuring system S (⎍⎍)
X8 = Nominal value output 1, 2, 3, 4, S
X12 = Touch probe 1
X13 = Touch probe 2
X21 = Data interface V.24/RS-232
X23 = Serial handwheel interface
X44 = +24 V supply voltage for PLC
X41 = PLC output
X42 = PLC input
X43 = Flat screen
X45 = TNC operating panel
X46 = Machine operating panel
X47 = PLC I/O-board PL 405B/410B (5V interface)

Power supply

X31 = +24V supply voltage for LE

6.1.2 Pin Layout: POWER SUPPLY LE 370

X31 Power supply (NC)
terminal strip (pluggable) 2-pin

Pin No.	Assignment
1	+24V
2	0V

6.1.3 Pin Layout: PROCESSOR BOARD LE 370

X1, X2, X3, X4 Encoders 1, 2, 3, 4
Sinusoidal input
Current interface 7 - 16µA
Flange socket with female insert (9-pin, D-SUB)

Pin No.	Assignment
6	I_1+
1	I_1–
8	I_2+
3	I_2–
9	I_0+
5	I_0–
7	+ 5V
2	0V
4	internal shield
Chassis	external shield = chassis

X6 Spindle encoder (position)
Square-wave input (TTL)
Flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1	Ua1
9	–Ua1
3	Ua2
11	–Ua2
14	Ua0
7	–Ua0
13	–UaS
12	+ 5V sense
10	0V sense
4	+ 5V
2	0V
5, 6, 8, 15	not connected
Chassis	external shield = chassis

X8 Nominal value output 1, 2, 3, 4, 5, S
Flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1	analogue output 1
3	analogue output 2
5	analogue output 3
7	analogue output 4
2	analogue input (0 ... 4.999V)
8	analogue output spindle
9	0V analogue output 1
11	0V analogue output 2
13	0V analogue output 3
14	0V analogue output 4
15	0V analogue output spindle
10	0V analogue input
Chassis	external shield = chassis
2, 10, 12	do not connect

X12 Touch probe 1 (TS)
Flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1	internal shield
3	standby
4	start
5	+15V
6	+15V
7	–battery warning
8	0V
9	trigger signal [1]
10	–trigger signal [1]
2, 11 to 15	not connected

[1] stylus at rest = low level (TS 120)

X13 Touch probe 2 (TT)
Flange socket with female insert (9-pin, D-SUB)

Pin No.	Assignment
1	standby
4	+15V
7	+5V
2	0V
8	trigger signal [1]
9	–trigger signal [1]
3, 5, 6	not connected

[1] stylus at rest = low level

X21 Data interface V.24/RS-232
Flange socket with female insert (9-pin, D-SUB)

Pin No.	Assignment
2	TXD
3	RXD
4	DSR
5	0V * 1
6	DTR
7	CTS
1, 9	not connected
Chassis	external shield

X23 Handwheel interface
Flange socket with female insert (9-pin, D-SUB)

Pin No.	Assignment HR 130/330	Assignment HR 332 336 / HRA 110
1,3,5	not connected	not connected
4	+ 12V	+ 12V
2	0 V	0 V
6	DTR	DTR
9	not connected	not connected
8	RXD	RXD
7	do not connect	TXD
Chassis	external shield = chassis	external shield = chassis

X43 Visual display unit (flat screen)
Flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1 to 6, 8	not connected
7	video
9	V SYNC
10	-
11	0V signal
12 to 13	do not connect
14	H SYNC
15	CLOCK
Chassis	external shield = chassis

X44 Power supply (PLC)
Terminal strip (pluggable) 3-pin

Pin No.	Assignment
1	+24V_A can be switched off with EMERG. STOP
2	+24V cannot be switched off with EMERG. STOP
3	0V

X41 PLC output
Flange socket with female insert (37-pin, D-SUB)

Pin No.	Assignment
1	O0
2	O1
3	O2
4	O3
5	O4
6	O5
7	O6
8	O7
9	O8
10	O9
11	O10
12	O11
13	O12
14	O13
15	O14
16	O15
17	O16
18	O17
19	O18
20	O19
21	O20
22	O21
23	O22
24	O23
25	O24 [2]
26	O25 [2]
27	O26 [2]
28	O27 [2]
29	O28 [2]
30	O29 [2]
31	O30 [2]
32	not connected
33	0V (PLC) [1]
34	control ready for operation [2]
35, 36, 37	+24V_A PLC [3]
Chassis	external shield

X42 PLC input
Flange socket with female insert (37-pin, D-SUB)

Pin No.	Assignment
1	I0
2	I1
3	I2
4	I3 acknowledgement for test "control ready for operation"
5	I4
6	I5
7	I6
8	I7
9	I8
10	I9
11	I10
12	I11
13	I12
14	I13
15	I14
16	I15
17	I16
18	I17
19	I18
20	I19
21	I20
22	I21
23	I22
24	I23
25	I24
26	I25
27	I26
28	I27
29	I28
30	I29
31	I30
32	I31
33,34	do not connect
35,36,37	0V PLC[1]
Chassis	external shield = chassis

[1] 0V PLC reference potential for testing
[2] cannot be switched off with ext. EMERGENCY STOP
[3] +24V_A PLC supply voltage for testing (can be switched off)

X45 TNC operating panel

Flange socket with female insert (37pin, D-SUB)

Pin No.	Assignment
1	RL0
2	RL1
3	RL2
4	RL3
5	RL4
6	RL5
7	RL6
8	RL7
9	RL8
10	RL9
11	RL10
12	RL11
13	RL12
14	RL13
15	RL14
16	RL15
17	RL16
18	RL17
19	RL18
20	SL0
21	SL1
22	SL2
23	SL3
24	SL4
25	SL5
26	SL6
27	SL7
28	RL19
29	RL20
30	do not connect
31	RL21
32	RL22
33	RL23
34	spindle override (wiper)
35	feed rate override (wiper)
36	–5V override potentiometer
37	0V override potentiometer
Chassis	external shield = chassis

= key matrix

X46 Machine operating panel

Flange socket with female insert (37pin, D-SUB)

Pin No.	Assignment
1	I128 coolant ON
2	I129 coolant OFF
3	I130 spindle OFF
4	I131 NC STOP
5	I132 NC START
6	I133 axis address key X–
7	I134 axis address key Y–
8	I135 axis address key Z–
9	I136 axis address key Z+
10	I137 axis address key Y+
11	I138 axis address key X+
12	I139 axis address key IV+
13	I140 axis address key IV–
14	I141 rapid traverse
15	I142 spindle ON
16	I143
17	I144
18	I145
19	I146
20	I147 FN 5
21	I148 FN 1
22	I149 FN 2
23	I150 FN 3
24	I151 FN 4
25	not connected
26	O0[1]
27	O1[1]
28	O2[1]
29	O3[1]
30	O4[1]
31	O5[1]
32	O6[1]
33	O7[1]
34, 35	0 V (PLC) [2]
36, 37	+ 24V PLC [3]

[1] O0...O7 simultaneously at X41 (PLC output)
[2] 0V PLC reference potential for testing
[3] +24V PLC supply voltage routed via fuse for the inputs I128 to I151

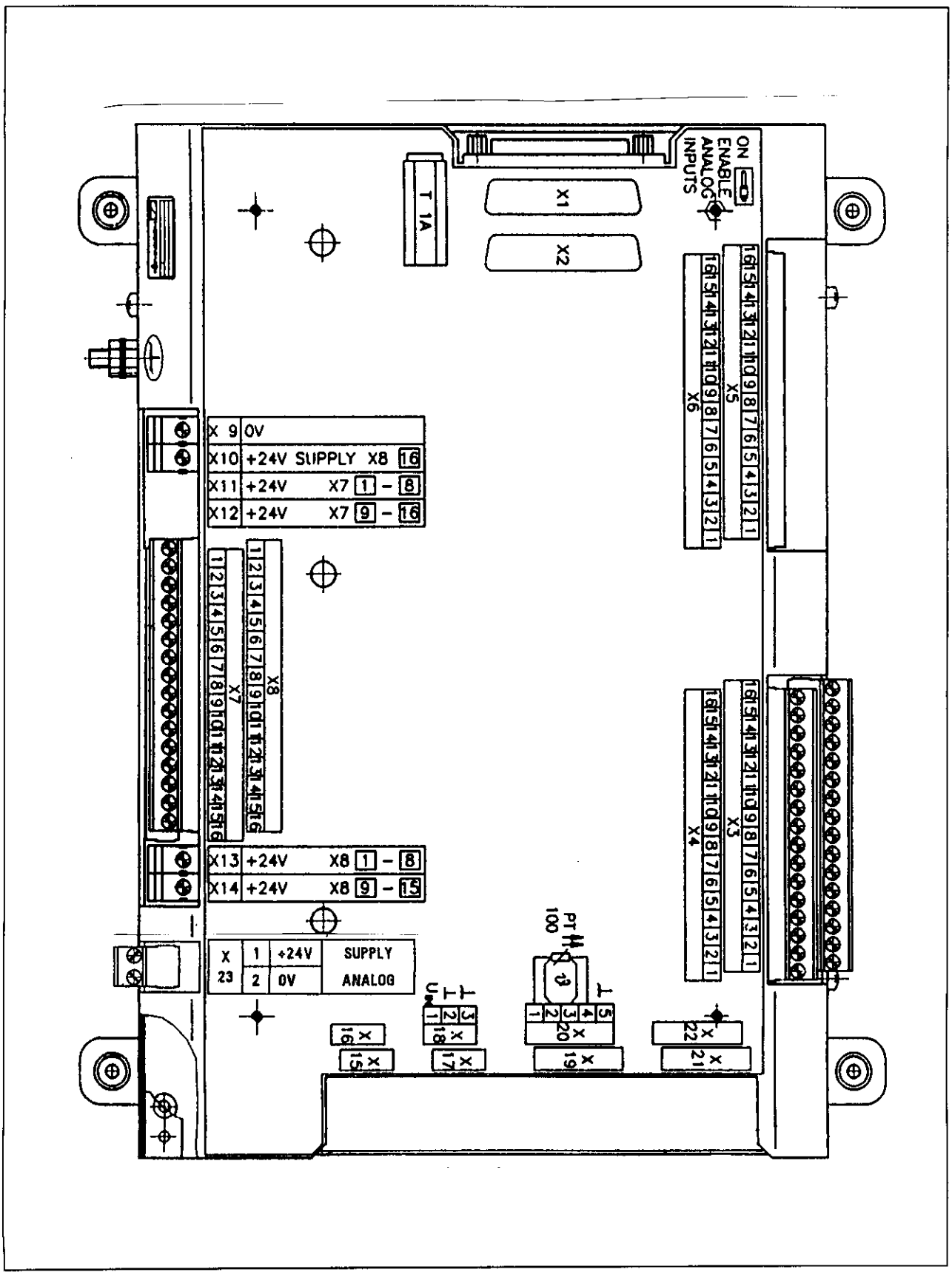
X47 PLC I/O-board PL 405B/410B

5V interface
Flange socket with male insert (25pin, D-SUB)

Pin No.	Assignment
1	0V
2	0V
3	0V
4	not connected
5	–address 6
6	INTERRUPT
7	–RESET
8	–WRITE EXTERN
9	WRITE EXTERN
10	–address 5
11	–address 3
12	–address 1
13	do not connect
14	board ID 4
15	board ID 3
16	not connected
17	not connected
18	–address 7
19	serial IN 1
20	EMERGENCY STOP
21	–serial OUT
22	serial OUT
23	–address 4
24	–address 2
25	–address 0

6.2 Connectors on the PLC I/O Boards

6.2.1 Connectors on PL 405B



6.2.2 Pin Layout: PL 405B

X1 Connection to logic unit	
Pin No.	**Assignment**
1	0V
2	0V
3	0V
4	serial IN 2
5	–address 6
6	INTERRUPT
7	–RESET
8	–WRITE EXTERN
9	WRITE EXTERN
10	–address 5
11	–address 3
12	–address 1
13	do not connect
14	+12V
15	+12V
16	board ID 2
17	board ID 1
18	–address 7
19	serial IN 1
20	EMERGENCY STOP
21	– serial OUT
22	serial OUT
23	–address 4
24	–address 2
25	–address 0

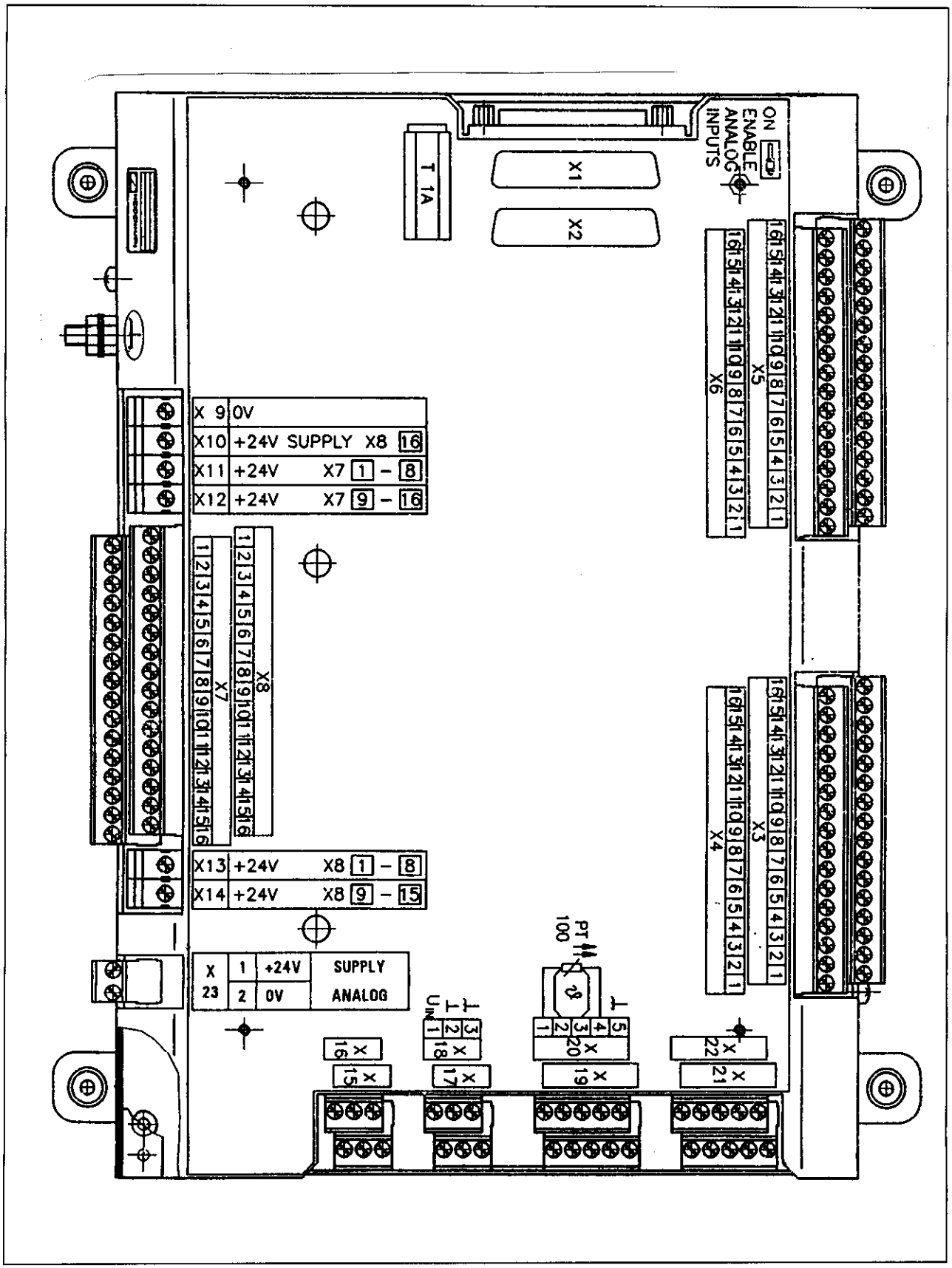
X3 PLC inputs	
Pin No.	**Assignment**
1	I64
2	I65
3	I66
4	I67
5	I68
6	I69
7	I70
8	I71
9	I72
10	I73
11	I74
12	I75
13	I76
14	I77
15	I78
16	I79

X4 PLC inputs	
Pin No.	**Assignment**
1	I80
2	I81
3	I82
4	I83
5	I84
6	I85
7	I86
8	I87
9	I88
10	I89
11	I90
12	I91
13	I92
14	I93
15	I94
16	I95

X8 PLC outputs and "control ready for operation"	
Pin No.	**Assignment**
1	O48
2	O49
3	O50
4	O51
5	O52
6	O53
7	O54
8	O55
9	O56
10	O57
11	O58
12	O59
13	O60
14	O61
15	O62
16	control ready for operation

X9, X10, X13, X14 PL 405B power supply	
Terminal	Assignment
X9	0V
X10	+24 V- supply of logic unit and "control ready for operation"
X13	+24 V- output supply O48 - O55
X14	+24 V- output supply O56 - O62

6.2.3 Connectors on PL 410B



6.2.4 Pin Layout: PL 410B

X1 Connection to logic unit	
Pin No.	**Assignment**
1	0V
2	0V
3	0V
4	serial IN 2
5	–address 6
6	INTERRUPT
7	–RESET
8	–WRITE EXTERN
9	WRITE EXTERN
10	–address 5
11	–address 3
12	–address 1
13	do not connect
14	+12V
15	+12V
16	board ID 2
17	board ID 1
18	–address 7
19	serial IN 1
20	EMERGENCY STOP
21	–serial OUT
22	serial OUT
23	–address 4
24	–address 2
25	–address 0

X2 Connection of second PL [1]	
Pin No.	**Assignment**
1	0V
2	0V
3	0V
4	not connected
5	–address 6
6	INTERRUPT
7	–RESET
8	–WRITE EXTERN
9	WRITE EXTERN
10	–address 5
11	–address 3
12	–address 1
13	do not connect
14	board ID 4
15	board ID 3
16	board ID 2
17	board ID 1
18	–address 7
19	serial IN 1
20	EMERGENCY STOP
21	–serial OUT
22	serial OUT
23	–address 4
24	–address 2
25	–address 0

X3 PLC inputs	
Pin No.	**Assignment**
1	I64
2	I65
3	I66
4	I67
5	I68
6	I69
7	I70
8	I71
9	I72
10	I73
11	I74
12	I75
13	I76
14	I77
15	I78
16	I79

X4 PLC inputs	
Pin No.	**Assignment**
1	I80
2	I81
3	I82
4	I83
5	I84
6	I85
7	I86
8	I87
9	I88
10	I89
11	I90
12	I91
13	I92
14	I93
15	I94
16	I95

[1] only one PL can be connected to TNC 370!

X5 PLC inputs	
Pin No.	**Assignment**
1	I96
2	I97
3	I98
4	I99
5	I100
6	I101
7	I102
8	I103
9	I104
10	I105
11	I106
12	I107
13	I108
14	I109
15	I110
16	I111

X6 PLC inputs	
Pin No.	**Assignment**
1	I112
2	I113
3	I114
4	I115
5	I116
6	I117
7	I118
8	I119
9	I120 [1]
10	I121 [1]
11	I122 [1]
12	I123 [1]
13	I124 [1]
14	I125 [1]
15	I126 [1]
16	I127 [1]

X7 PLC outputs	
Pin No.	**Assignment**
1	O32
2	O33
3	O34
4	O35
5	O36
6	O37
7	O38
8	O39
9	O40
10	O41
11	O42
12	O43
13	O44
14	O45
15	O46
16	O47

X8 PLC outputs and "control ready for operation"	
Pin No.	**Assignment**
1	O48
2	O49
3	O50
4	O51
5	O52
6	O53
7	O54
8	O55
9	O56
10	O57
11	O58
12	O59
13	O60
14	O61 [1]
15	O62 [1]
16	control ready for operation

[1] With active analogue inputs (depending on the position of the ENABLE ANALOGUE INPUTS switch on PL410B) these PLC inputs and outputs are not available.

X9, X10, X11, X12, X13, X14 **Power supply of PL**	
Terminal	Assignment
X9	0 V
X10	+24 V- supply of logic unit and "control ready for operation"
X11	+24 V- output supply O32 - O39
X12	+24 V- output supply O40 - O47
X13	+24 V- output supply O48 - O55
X14	+24 V- output supply O56 - O62
X23 [1] PIN 1	+24 V- supply of analogue part
X23 [1] PIN 2	0 V for analogue part

X15 [1], **X16** [1], **X17** [1], **X18** [1] **Analogue inputs ± 10V**	
Pin No.	**Assignment**
1	voltage input (± 10V)
2	0V
3	shield

X19 [1], **X20** [1], **X21** [1], **X22** [1] **Inputs for PT 100 thermistors** **Four-wire connector with constant current source**	
Pin No.	**Assignment**
1	I+ constant current for PT 100
2	U+ measuring input
3	U- measuring input
4	I- constant current for PT 100
5	shield

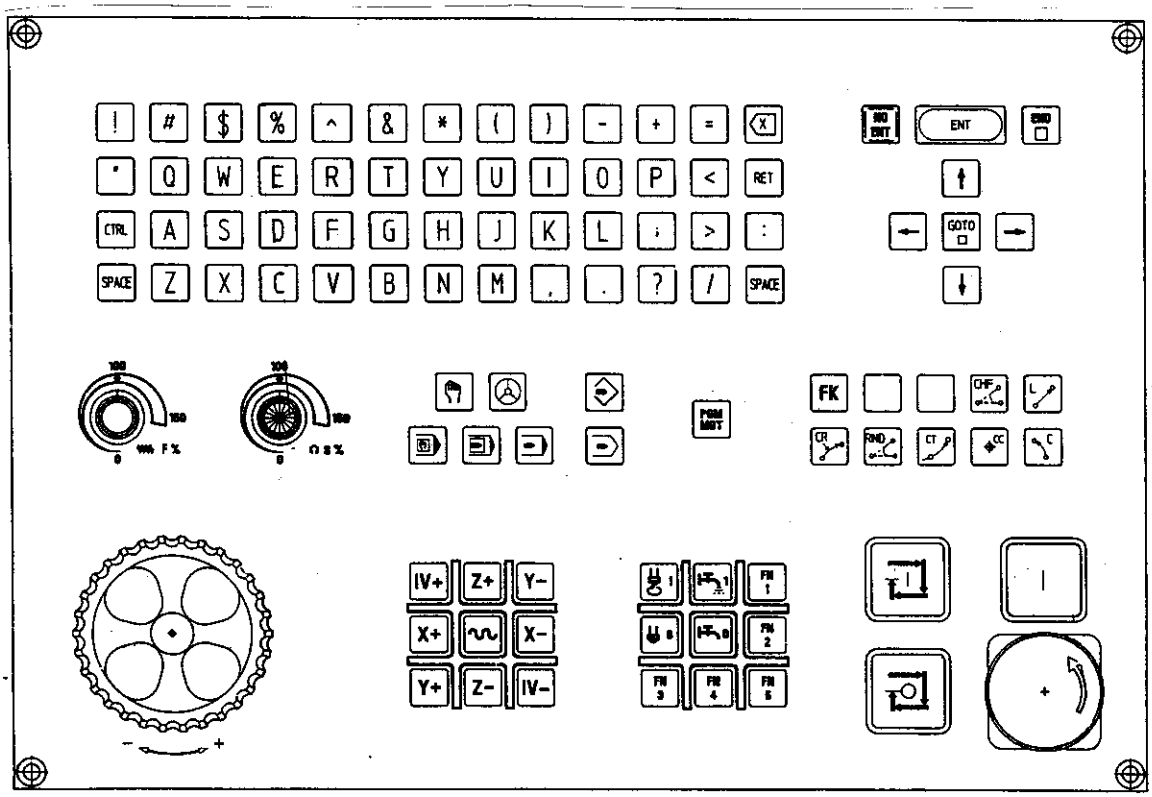
[1] not inserted on PL 410B, version 12

Note: The analogue part of PL 410B is **not** evaluated by TNC 370!

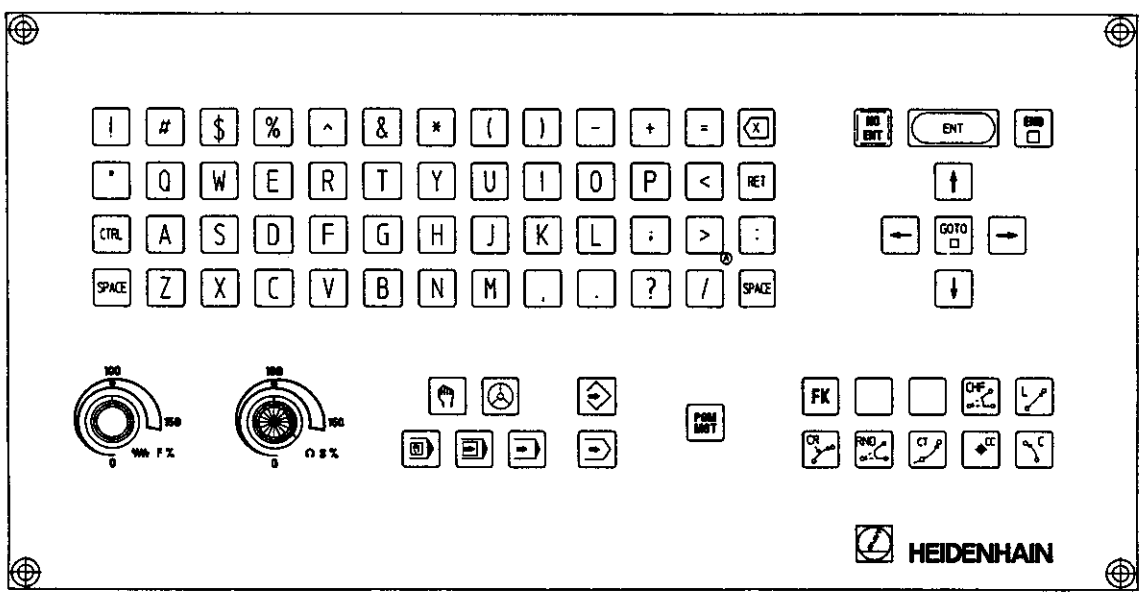
6.3 Connectors on the Keyboard Units

6.3.1 Connectors on TE 370/371

TE 370



TE 371



6.3.2 Pin Layout: TE 370/371

X1 Connection of BF 370 (soft keys)

Flange socket with female insert
plug-type connector (10-pin, 2-row)

Pin No.	Assignment
1a	SL0
2a	SL1
3a	SL2
4a	SL3
5a	SL4
6a	SL5
7a	SL6
8a	SL7
9a	RL0
10a	RL1
1b	RL2
2b	RL3
3b	RL4
4b	RL5
5b	RL12
6b	RL13
7b	RL14
8b	RL15
9b	RL16
10b	RL17

= key matrix

X2 Connection of LE 370 (NC keypad)

Flange socket with male insert (37-pin, D-SUB)

Pin No.	Assignment
1	RL0
2	RL1
3	RL2
4	RL3
5	RL4
6	RL5
7	RL6
8	RL7
9	RL8
10	RL9
11	RL10
12	RL11
13	RL12
14	RL13
15	RL14
16	RL15
17	RL16
18	RL17
19	RL18
20	SL0
21	SL1
22	SL2
23	SL3
24	SL4
25	SL5
26	SL6
27	SL7
28	SL19
29	SL20
30	do not connect
31	RL21
32	RL22
33	RL23
34	spindle override (wiper)
35	feed rate override (wiper)
36	+ 5V
37	0V

X3 Connection of LE 370 (machine operating panel, TE 370 only)

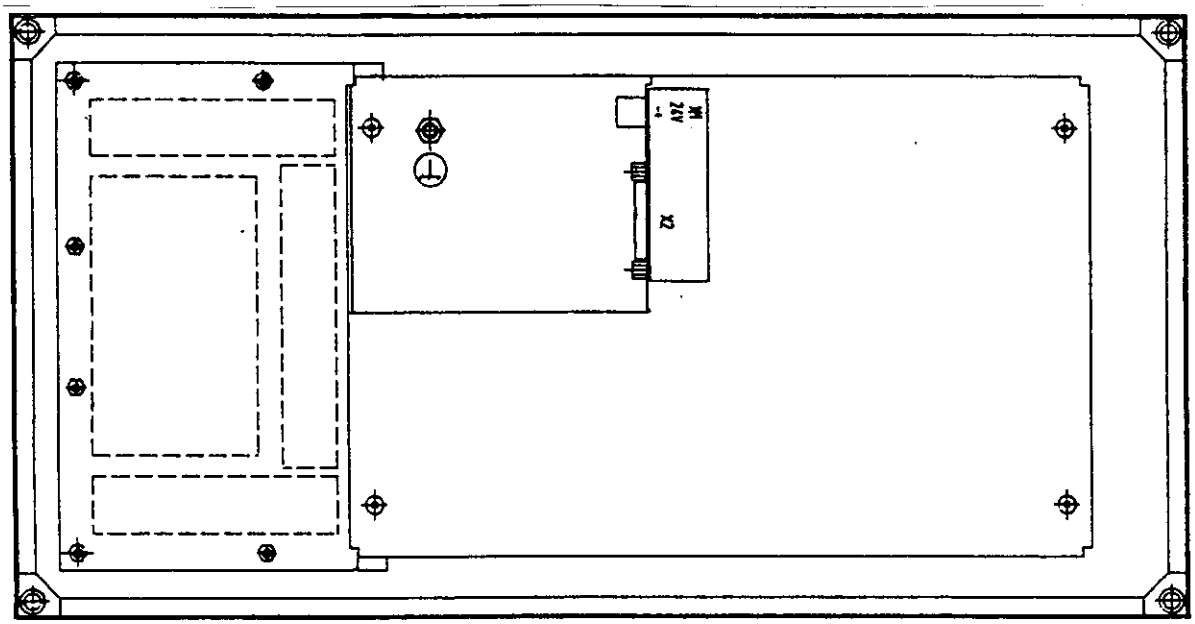
Flange socket with male insert (37-pin, D-SUB)

Pin No.	Assignment
1	I 128 coolant ON
2	I 129 coolant OFF
3	I 130 spindle OFF
4	I 131 NC STOP
5	I 132 NC START
6	I 133 axis address key X–
7	I 134 axis address key Y–
8	I 135 axis address key Z–
9	I 136 axis address key Z+
10	I 137 axis address key Y+
11	I 138 axis address key X+
12	I 139 axis address key IV+
13	I 140 axis address key IV–
14	I 141 rapid traverse
15	I 142 spindle ON
16 to 19	not connected
20	I 147 FN 5
21	I 148 FN 1
22	I 149 FN 2
23	I 150 FN 3
24	I 151 FN 4
25	(I 152) [1]
26 to 35	not connected
36, 37	+24V PLC

[1] not evaluated by TNC 370.

6.4 Connectors on the Visual Display Units

6.4.1 Connectors on BF 370/371



6.4.2 Pin Layout: Visual Display Unit BF 370/371

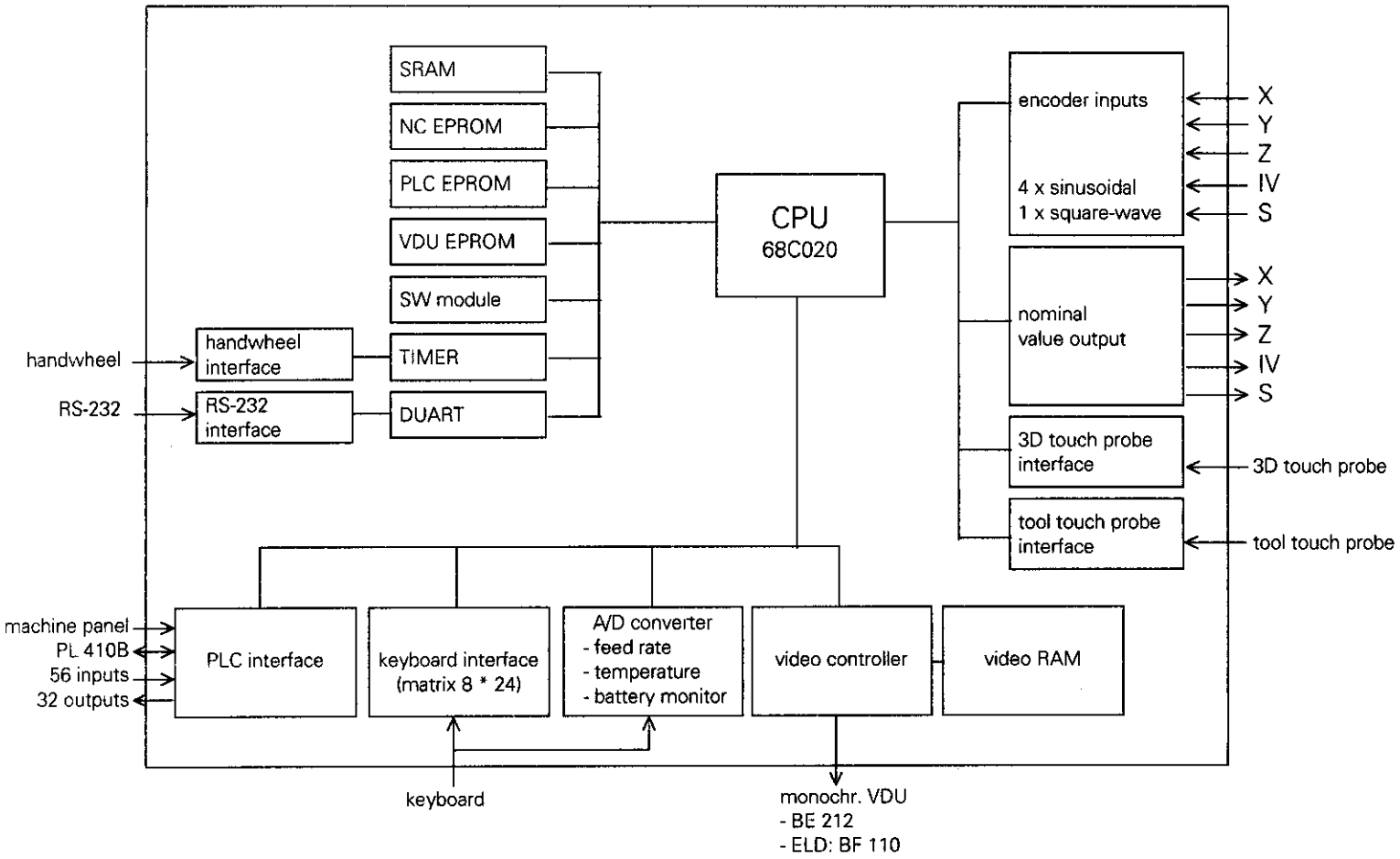
X1 Power supply
Flange socket with male insert (15-pin)

Pin No.	Assignment
1	+24V
2	0V

X2 Connection of LE 370
Flange socket with male insert (15-pin, D-SUB)

Pin No.	Assignment
1 to 6, 8	not connected
7	video
9	V SYNC
10	not connected
11	0V signal
12 to 13	not connected
14	H SYNC
15	CLOCK
Chassis	external shield = chassis

7. Block Diagram



8. Board Description

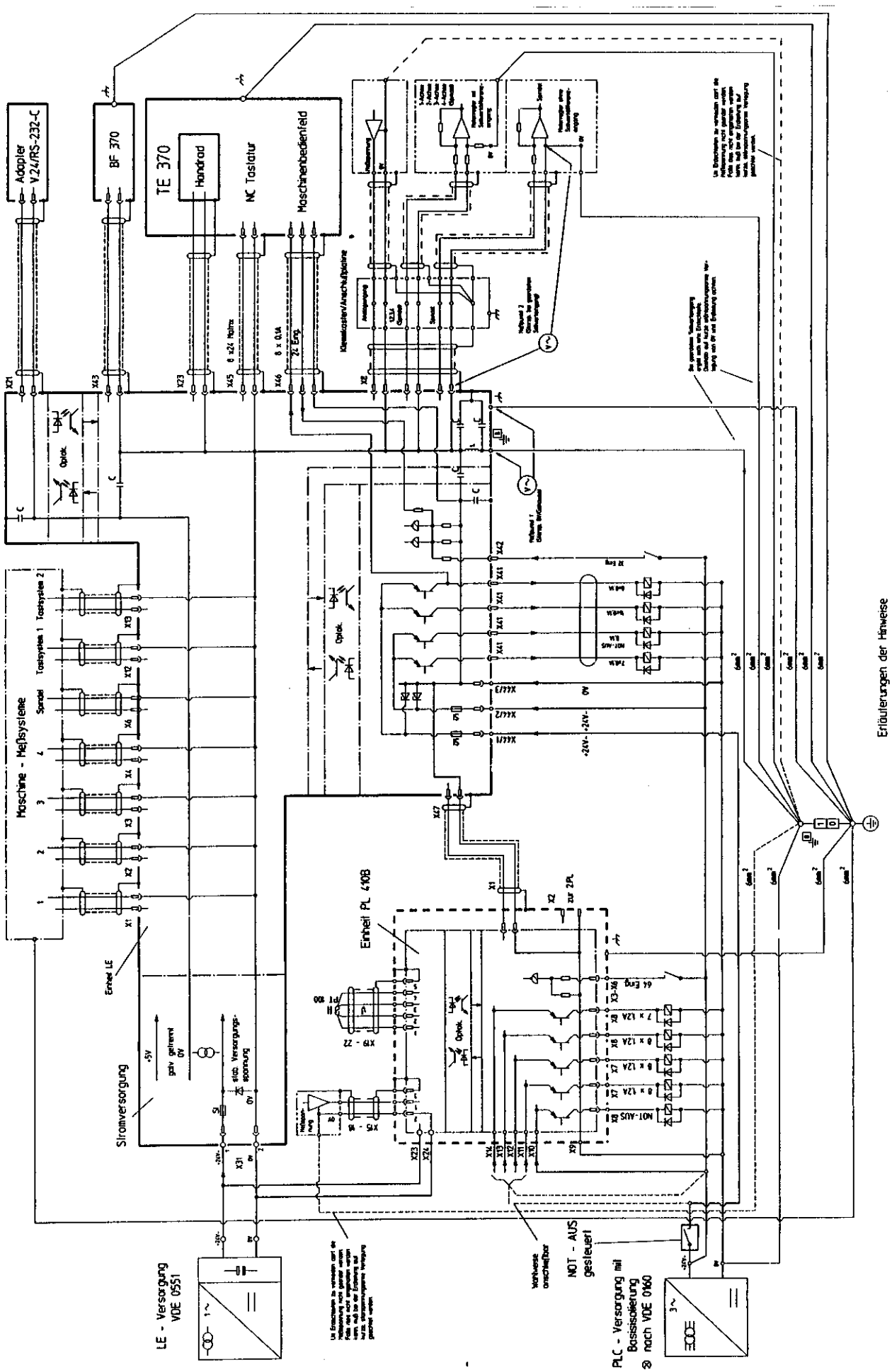
LE 370 Processor Board

- **Interface**
  Data interface V.24/RS-232-C
  Data interface V.11/RS-422
  Handwheel HR 130/330
  Encoder inputs
  3D touch probe
  57 PLC inputs
  31 PLC outputs
  Visual display unit
  Keyboard unit
  Machine operating panel
  PLC I/O-boards

- **Monitoring functions**
  EMERGENCY STOP
  Encoder inputs
  Axis positions
  Program memory
  Data processing
  EMERGENCY STOP
  Temperature
  Voltages
  Buffer battery

- **Storage**
  Operating program (NC software)
  PLC programs
  Machine parameters
  Compensation value lists
  NC programs (by the end user)

9. Grounding Diagram



10. Power Supply

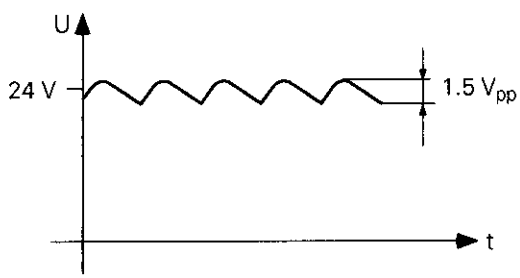
10.1 External Power Supply Requirements

The voltages must correspond to the following definitions:

Assembly		Supply voltage	Voltage Range DC Mean Value	Max. Current Consumption	Power Consumption
LE	NC	24V - (VDE 0551)	lower limit 20.4V ⎓ upper limit 31V ⎓ [1]	LE 370: 0,7A	LE 370: ca. 17W
	PLC	24V - (VDE 0160)		approx. 2.0A if half of the outputs are active simultaneously	approx. 48W if half of the outputs are active simultaneously
PL 405B PL 410B	PLC	24V– (VDE 0160)		approx. 20A if half of the outputs are active simultaneously	approx. 480W if half of the outputs are active simultaneously
	analogue part	24V– (VDE 0551)			
BF 370/371				approx. 1A with full display	24W typ. 32W max.

[1] Voltages up to 36V ⎓ are permissible with t < 100ms.

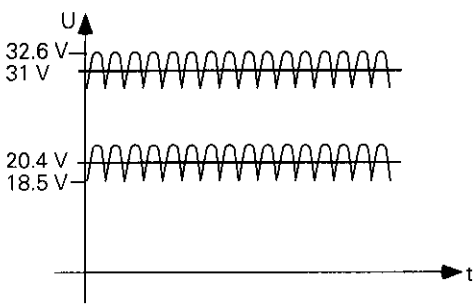
10.1.1 NC Power Supply



The NC part of the LE must not be connected to the control voltage of the machine tool. It requires its own external power supply generated separately according to the German standard VDE 0551.
24V DC voltage with a permissible AC component (ripple voltage) of 1.5Vpp (recommended filtering capacitor 10 000µF/40V -).

10.1.2 PLC Power Supply

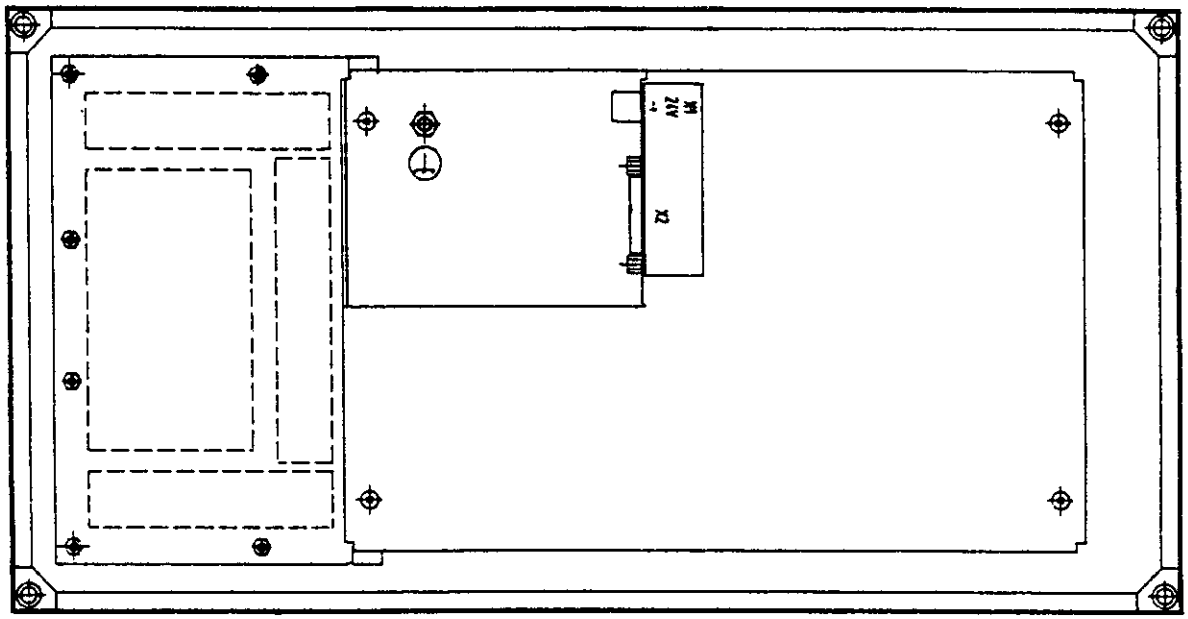
The PLC part (PLC inputs and outputs) of the LE, PL and PA is operated with a control voltage of 24V- of the machine tool (generated according to VDE 0550).
The installation and connection of the measuring resistors and the analogue inputs (PL 410B) must be safe from contact according to VDE 0160 (section 5.5.1).
If this cannot be ensured, PLC and PL 410 (PA 110) have to be powered according to VDE 0551.
Superimposed AC voltage components arising from a non-controlled three-phase bridge connection with a ripple factor of 5% (see German standard DIN 40110/10.75, section 1.2) are permissible. Thus the highest absolute value for the upper voltage limit is 32.6V; the smallest value for the lower voltage limit is 18.5V.



The 0V line of the PLC power supply must be connected to the central signal ground (line ∅ ≥ 6mm^2) of the machine tool. The grounding. The ground connector on the PL410 housing must be connected to the protective ground (line ∅ ≥ 6mm^2). To avoid ground loops the measuring voltage at the analogue inputs must not be grounded.

10.1.3 Power Supply of the Visual Display Units

BF 370/371



X2 = Connection to logic unit

X1 Power Supply

Terminal strip (pluggable) 2-pin

Pin No.	Assignment
1	+24V [1]
2	0V

[1] Definition see section 10.1.2

10.2 Power Supply of the NC

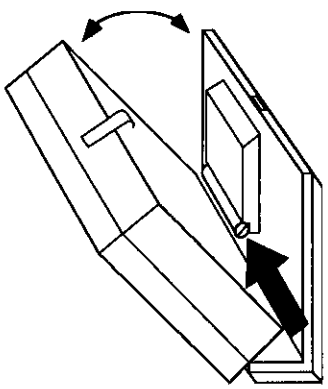
The power supply line of the NC is connected to the terminals of X31.

X31 **NC Power Supply**

Pin No.	Assignment
1	+ 24 V
2	0 V

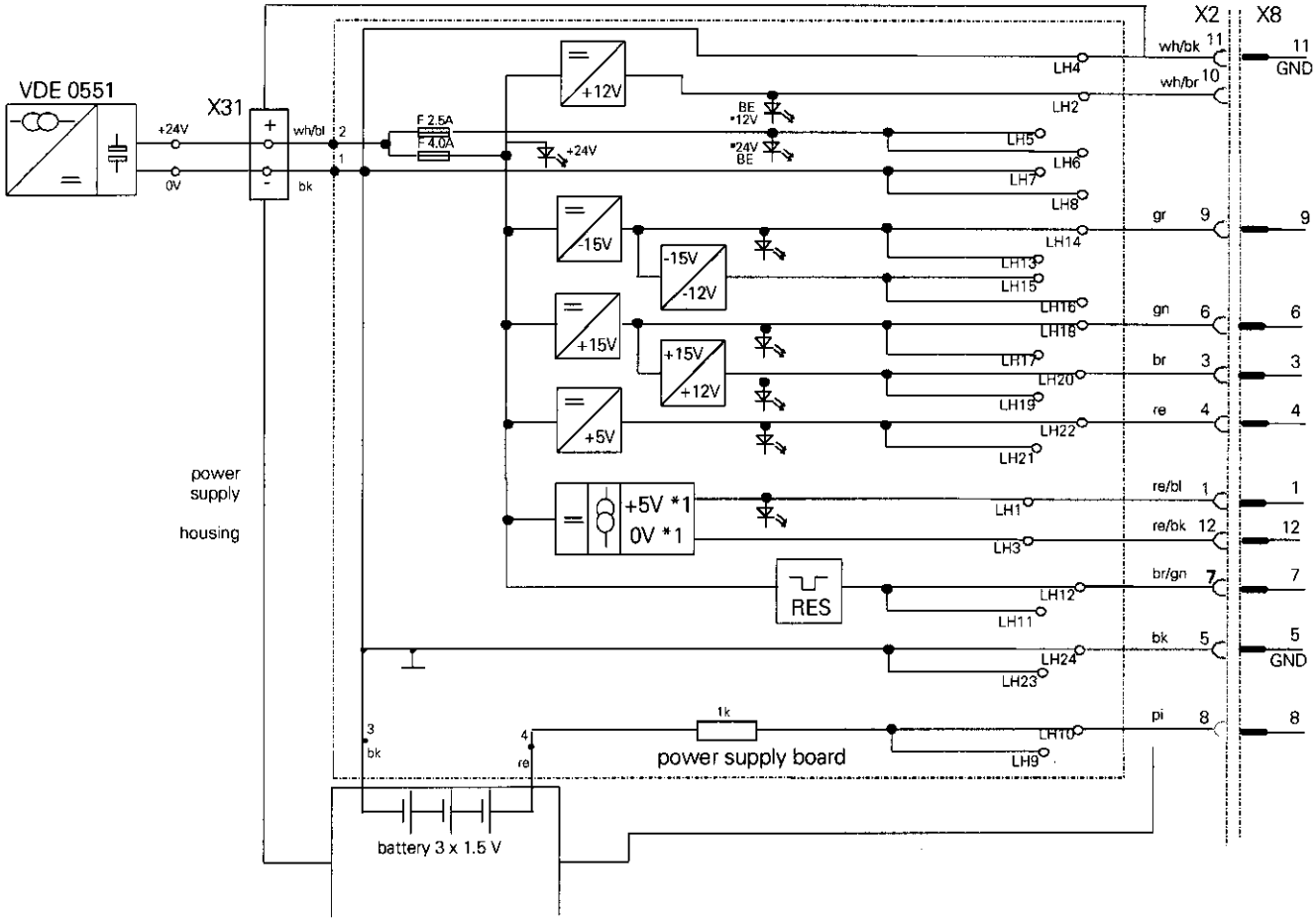
The different voltages for the LE are transformed from the voltage fed (+24V) in the POWER SUPPLY assembly (see block diagram in section 10.2.1).

The input and output voltages are displayed by LEDs. The states of the individual voltages can only be displayed **approximately** by the LEDs. The exact values must be measured; the measured values must correspond to the table in section 10.2.1.



Power supply unit

10.2.1 NC Power Supply: Block Diagram



X2: connector (12-pin) of connecting cable "power supply <-> processor board"
X8: socket (12-pin) on the processor board of TNC 370

Voltage Table

Test point on power supply board	Reference point on power supply board	Output	UNOM [V]	UMIN [V]	UMAX [V]	INOM [A]
LH22	LH24 (0V)	+ 5V (UP)	+ 5.05	+ 5.00	+ 5.10	1.3
LH20	LH24 (0V)	+ 12V [1]	+ 12	+ 11.4	+ 12.6	–
LH18	LH24 (0V)	+ 15V	+ 15.0	+ 14.4	+ 15.6	0.3
LH14	LH24 (0V)	- 15V	- 15.0	- 14.4	- 15.6	0.2
LH10	LH24 (0V)	+ UBATT	+ 4.5	+ 3.9	-	approx. 10 µA
LH1	LH3 (0V*1)	+ 5V * 1 [2]	+ 5	+ 4.75	+ 5.25	0.3
LH12 (reset) [3]						

[1] not used for operation with flat screen BF 370/371
[2] floating
[3] reset U_{Lmax} = 0.4 V, U_{Hmin} = 3.9 V

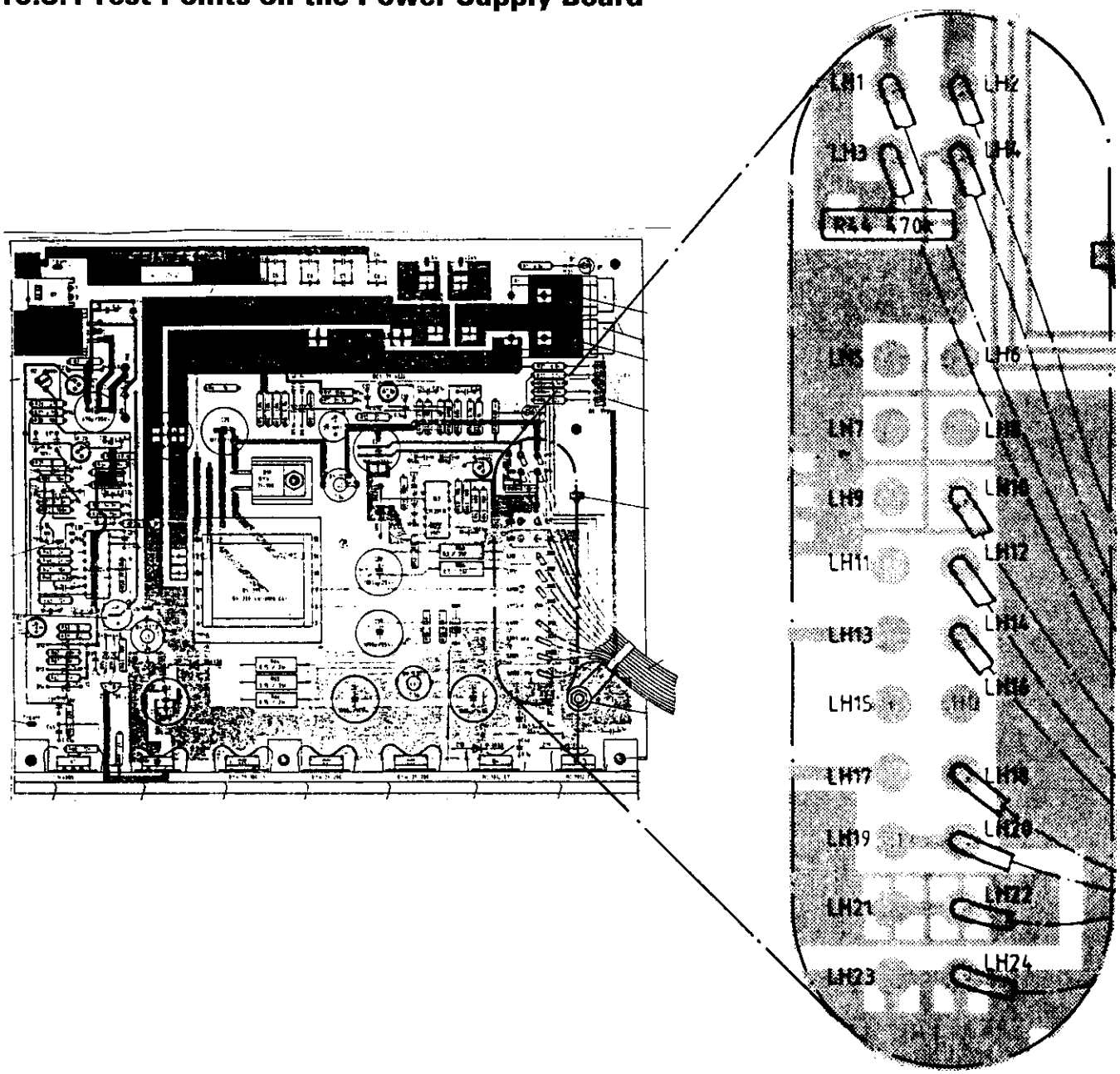
10.3 Checking the Power Supply Unit

Two low-voltage fuses are located on the POWER SUPPLY assembly. The fuse F 2.5A protects the output voltage of +24V BE (not used if TNC370 is operated with a flat screen), and the fuse F 4.0A protects the remaining voltages (see block diagram, section 10.2.1). If an error occurs in the power supply (all voltages missing), first check the +24V at the supply line (2-pin terminal strip X31) and then the low-voltage fuse F 4.0A.

The voltages can be measured directly on the power supply board and on the processor board (sections 10.3.1 and 10.3.2).
The values and their tolerances can be seen from the corresponding tables. If the measured values deviate distinctly from the values in the table, the power supply assembly is defective.

Observe the safety instructions!
The power supply unit does not work without load.
(Base load is required)

10.3.1 Test Points on the Power Supply Board



Voltage Table

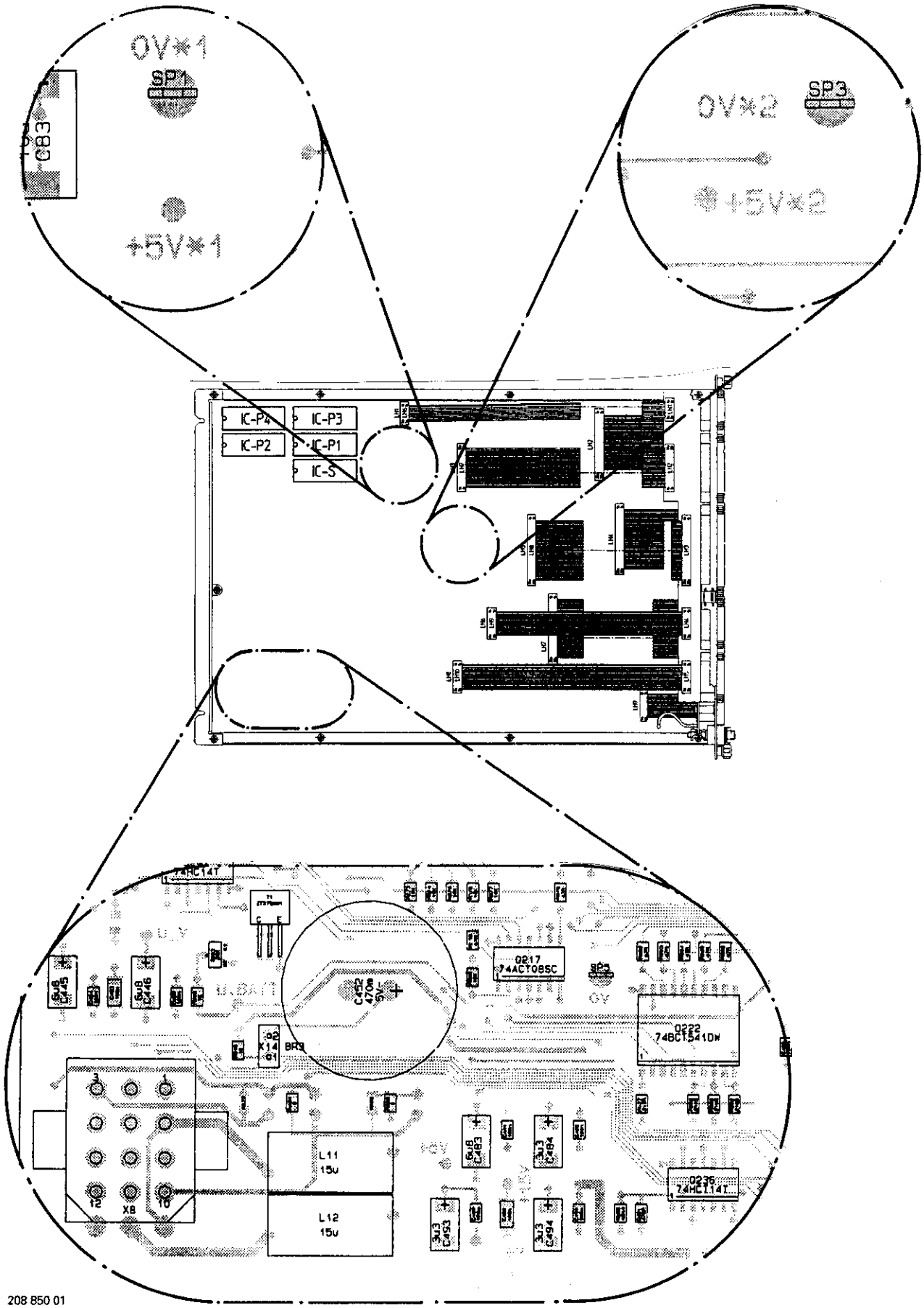
Test point on power supply board	Reference point on power supply board	Output	UNOM [V]	UMIN [V]	UMAX [V]	INOM [A]
LH22	LH24 (0V)	+ 5V (UP)	+ 5.05	+ 5.00	+ 5.10	1.3
LH20	LH24 (0V)	+ 12V [1]	+ 12	+ 11.4	+ 12.6	–
LH18	LH24 (0V)	+ 15V	+ 15.0	+ 14.4	+ 15.6	0.3
LH14	LH24 (0V)	- 15V	- 15.0	- 14.4	- 15.6	0.2
LH10	LH24 (0V)	+ UBATT	+ 4.5	+ 3.9	-	ca. 10 µA
LH1	LH3 (0V*1)	+ 5V * 1 [2]	+ 5	+ 4.75	+ 5.25	0.3
LH12 (reset) [3]						

[1] not used for operation with flat screen BF 370/371
[2] floating
[3] reset U_{Lmax} = 0.4 V, U_{Hmin} = 3.9 V

10.3.2 Voltage Test Points and Optical Displays on the Processor Board

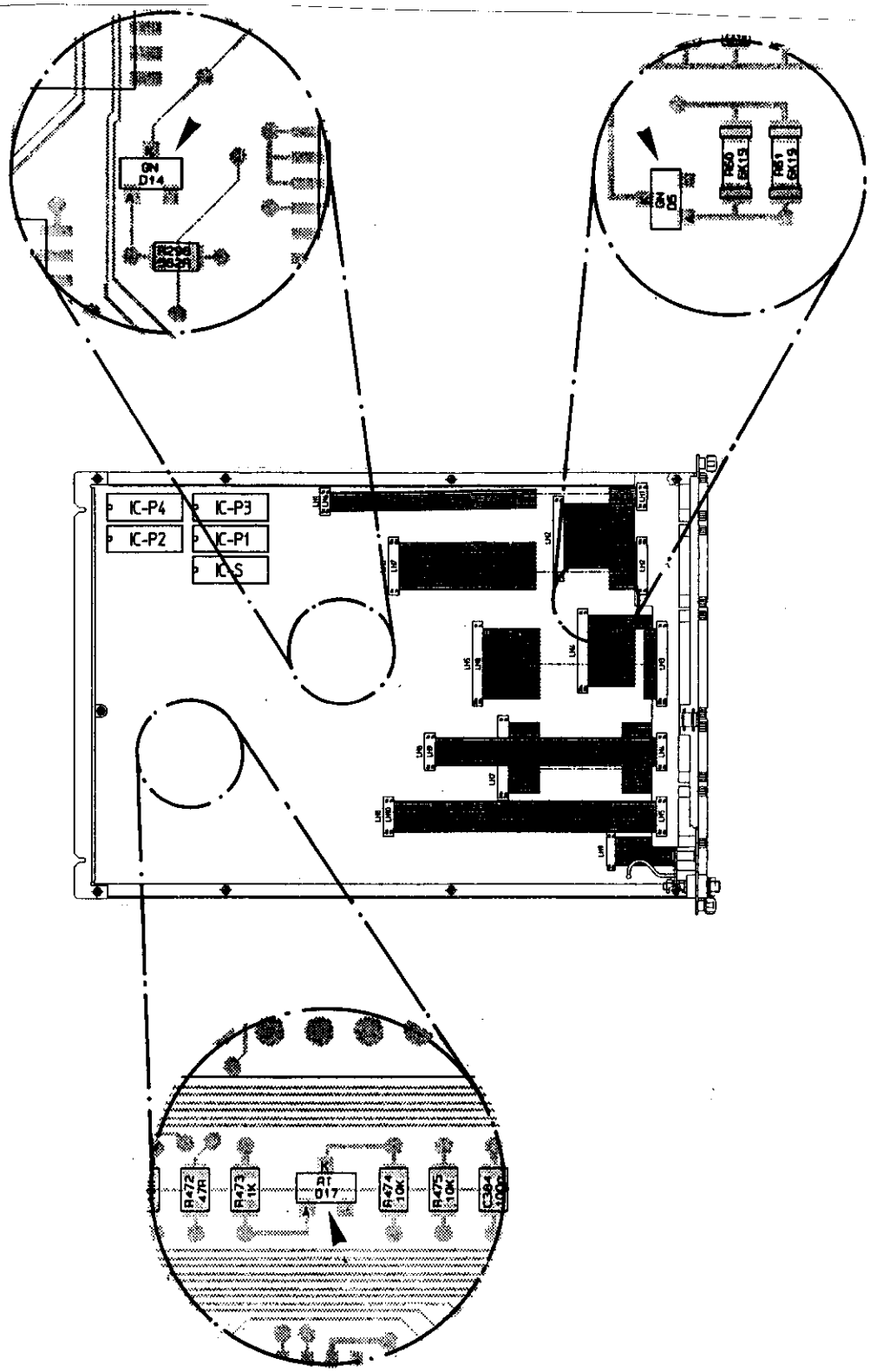
5V supply for data interface (isolated)

5V supply for PLC (isolated); created from +24V PLC supply voltage



LED (green) blinks → TNC operates correctly

LED (green) lit → +24V PLC supply voltage available



LED (red) lit, when the processor is in HOLD state
(TNC can only be rebooted by power interruption)

10.4 Power Supply of the PLC

The power supply of the internal PLC of LE 370 is connected to the terminal strip X44.

X44 PLC power supply of LE 370

Terminal strip (pluggable) 3-pin

Pin No.	Assignment
1	+ 24 V_A, can be switched off via EMERGENCY STOP
2	+ 24 V , cannot be switched off via EMERGENCY STOP
3	0V

Fuses: F1: 3.15A (+ 24V_A can be switched off)
F2: 2.0A (+ 24V cannot be switched off)

X9, X10, X11, X12, X13, X14 Power supply of PL 405B/410B

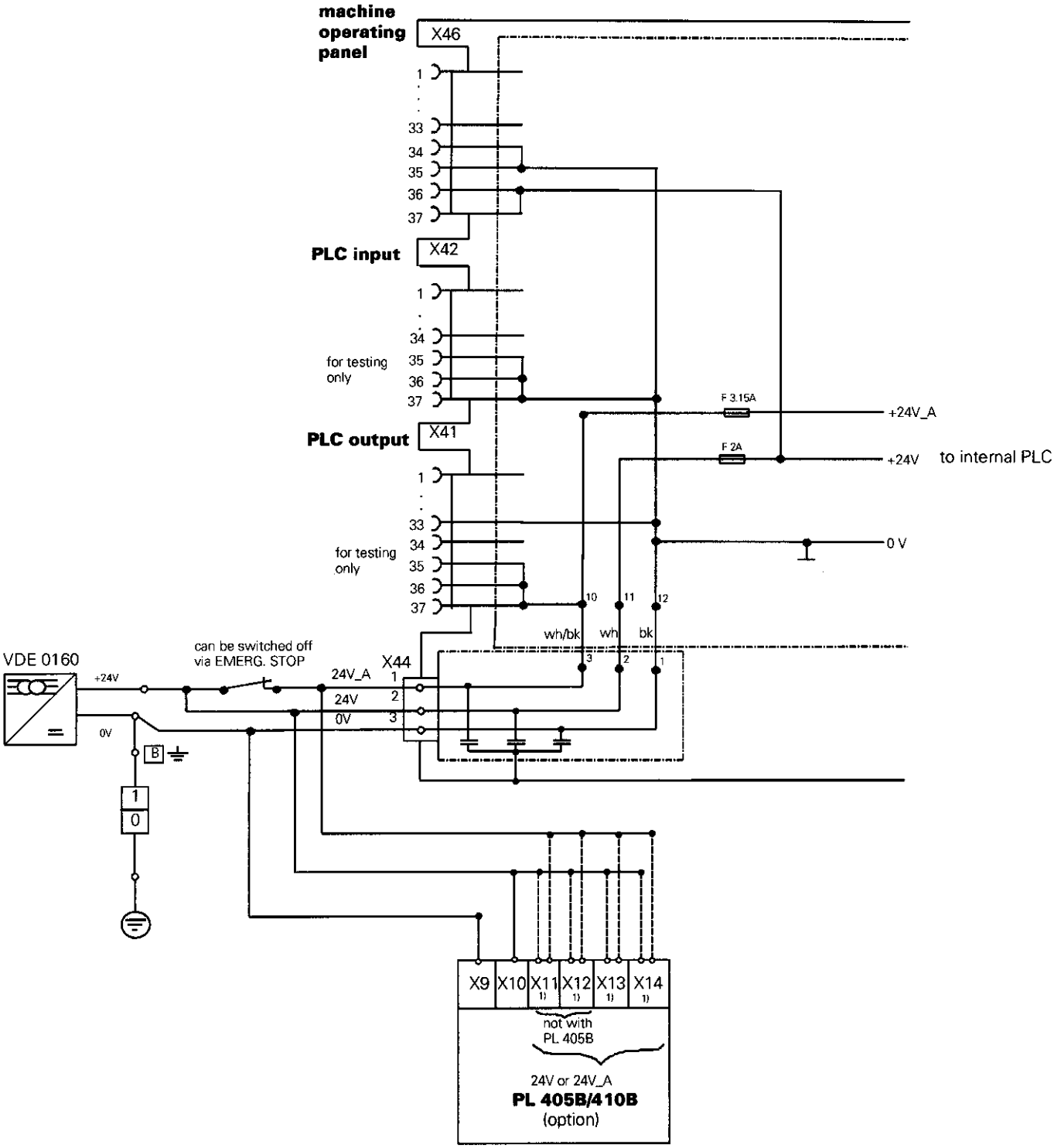
Terminal strip

Terminal	Assignment
X9	0V
X10	+ 24V- supply of logic unit and "control ready for operation"
X11 [1]	+ 24V- supply of logic unit for outputs O32 - O39
X12 [1]	+ 24V- supply of logic unit for outputs O40 - O47
X13	+ 24V- supply of logic unit for outputs O48 - O55
X14	+ 24V- supply of logic unit for outputs O56 - O62
X23 [2] PIN 1	+ 24V- supply of analogue part (pluggable)
X23 [2] PIN 2	0V for analogue part (pluggable)

[1] not for PL 405

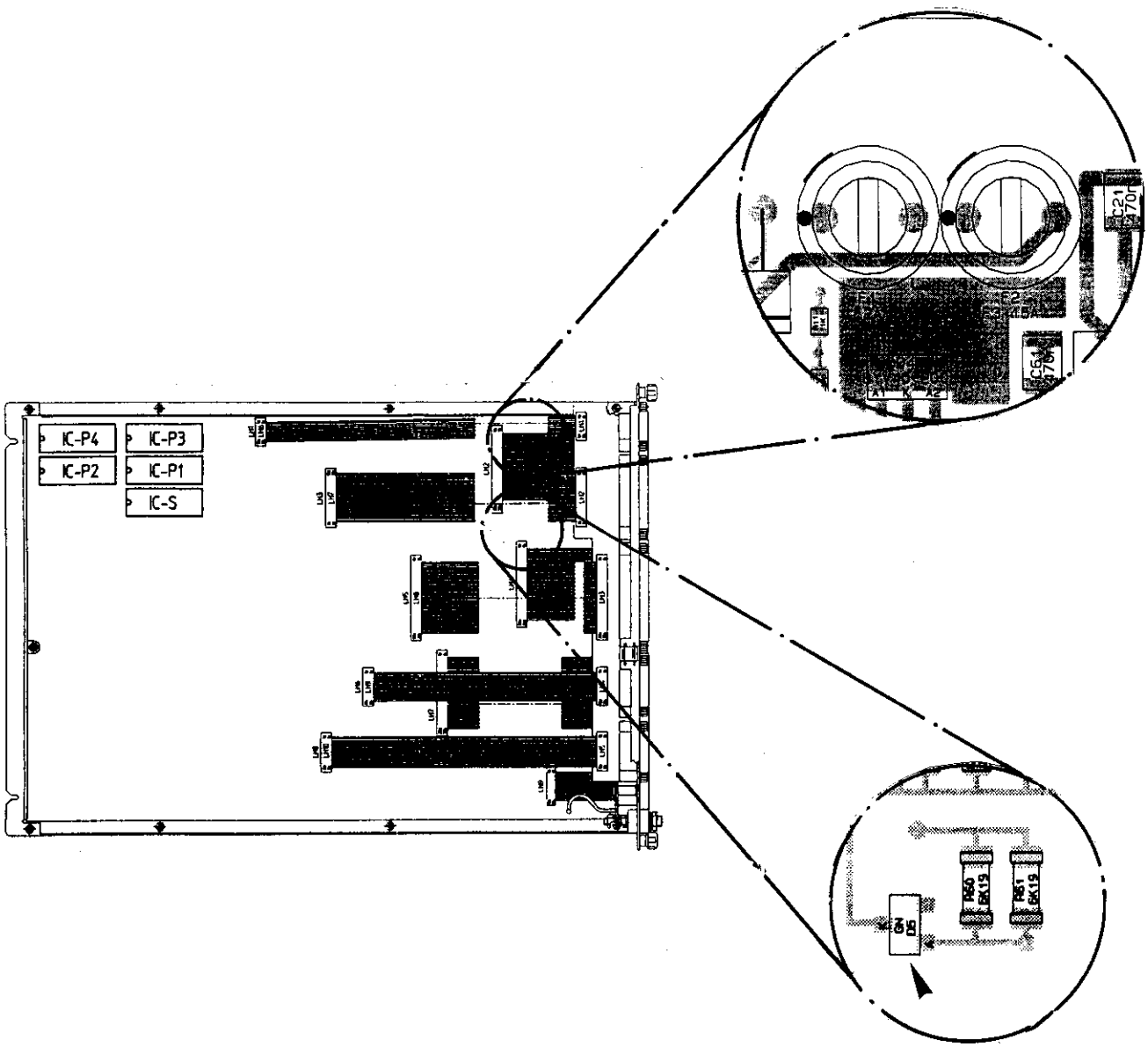
[2] not for PL 410B, version 12
The analogue part of PL 410B is **not** evaluated by TNC 370!

10.4.1 PLC Power Supply: Block Diagram



X44 Pin 1, +24V_A (PLC can be switched off): power supply for the PLC outputs O0 - O23.
X44 Pin 2, +24V (PLC cannot be switched off): power supply for the PLC outputs O24 - O30 and output "control ready for operation"

10.4.2 Positions of the Fuses on the Processor Board



LED (green) lit → +24V- PLC power supply available

10.5 Buffer Battery

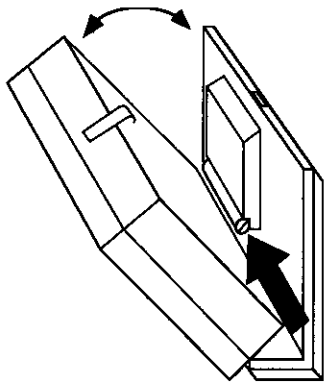
The buffer battery is the voltage source for the program memory when the machine tool is switched off.

If the error message

EXCHANGE BUFFER BATTERY

is generated, the batteries must be exchanged within one week.

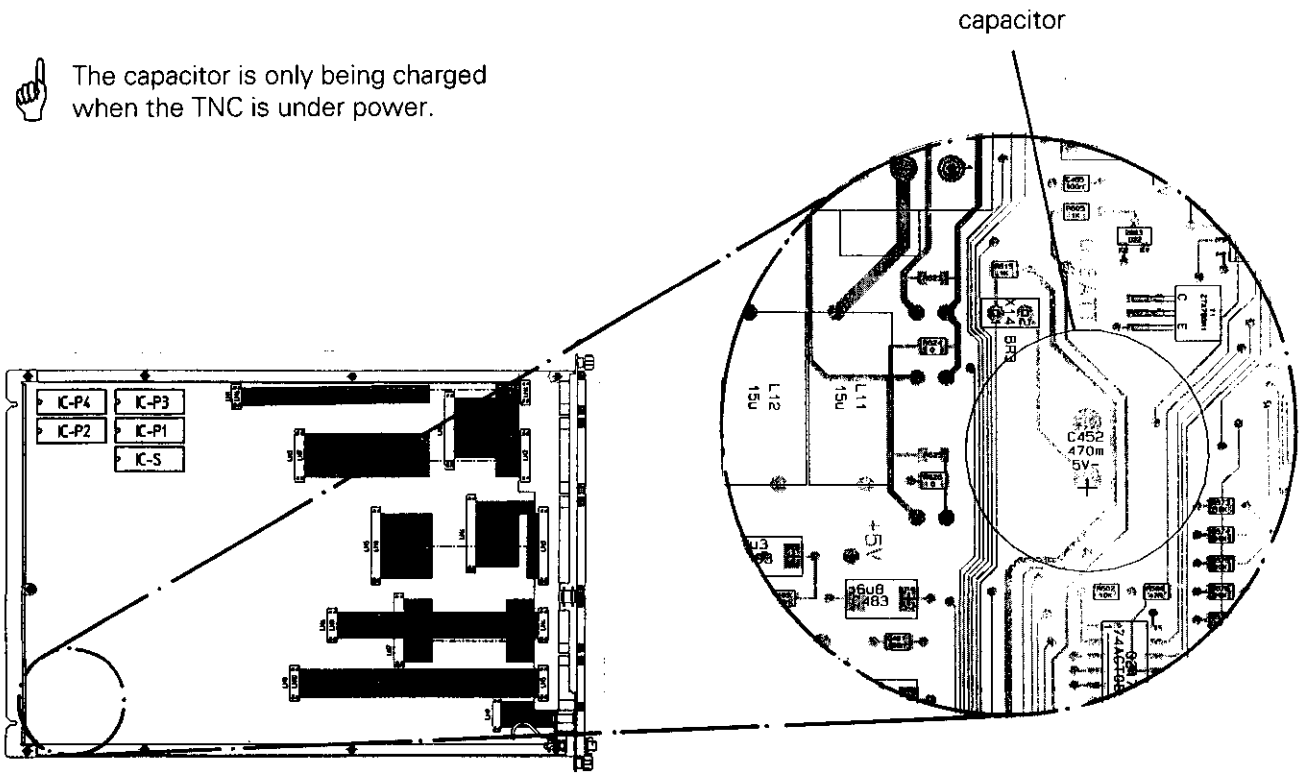
The buffer batteries are located behind a screw fitting in the power supply of the LE. To exchange the batteries, open the LE by undoing the snaps.



buffer battery

In order to protect the program memory of TNC 370, a capacitor (on the processor board) is used in addition to the batteries. Thus, the line voltage may be switched off during battery exchange.
Without the batteries the capacitor is capable of maintaining the memory contents for about one day.

The capacitor is only being charged when the TNC is under power.

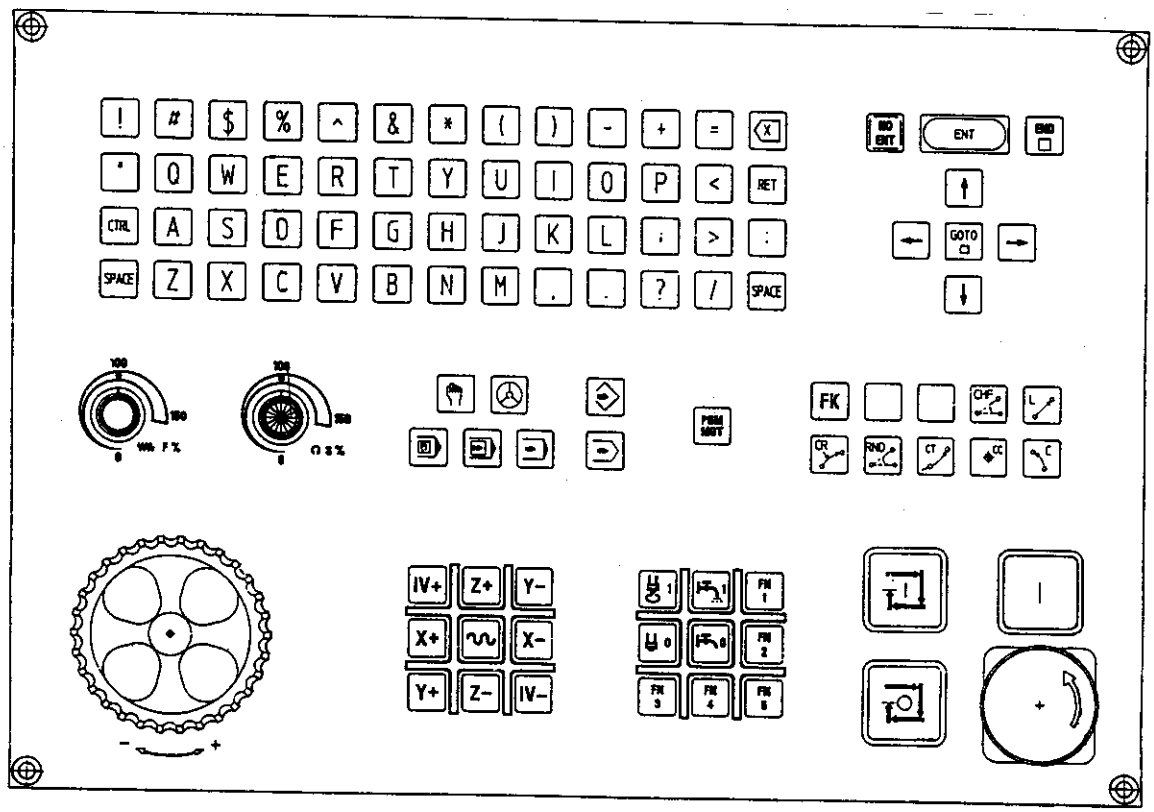


processor board

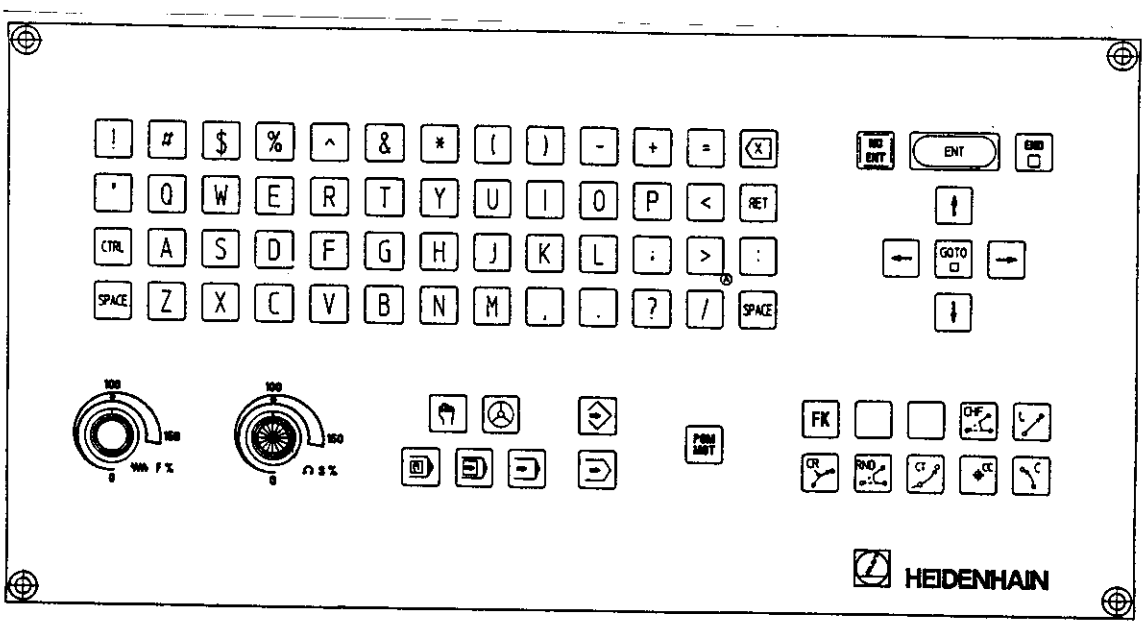
11. Keyboard Unit TE 370/371

11.1 Overview

TE 370 Id.No. 288 713 ..



TE 371 Id.No. 293 420 ..



11.2 Checking the Keyboard Unit

The keyboard unit can be checked fast and reliably with the measuring adapter.

11.2.1 Checking the Key Functions

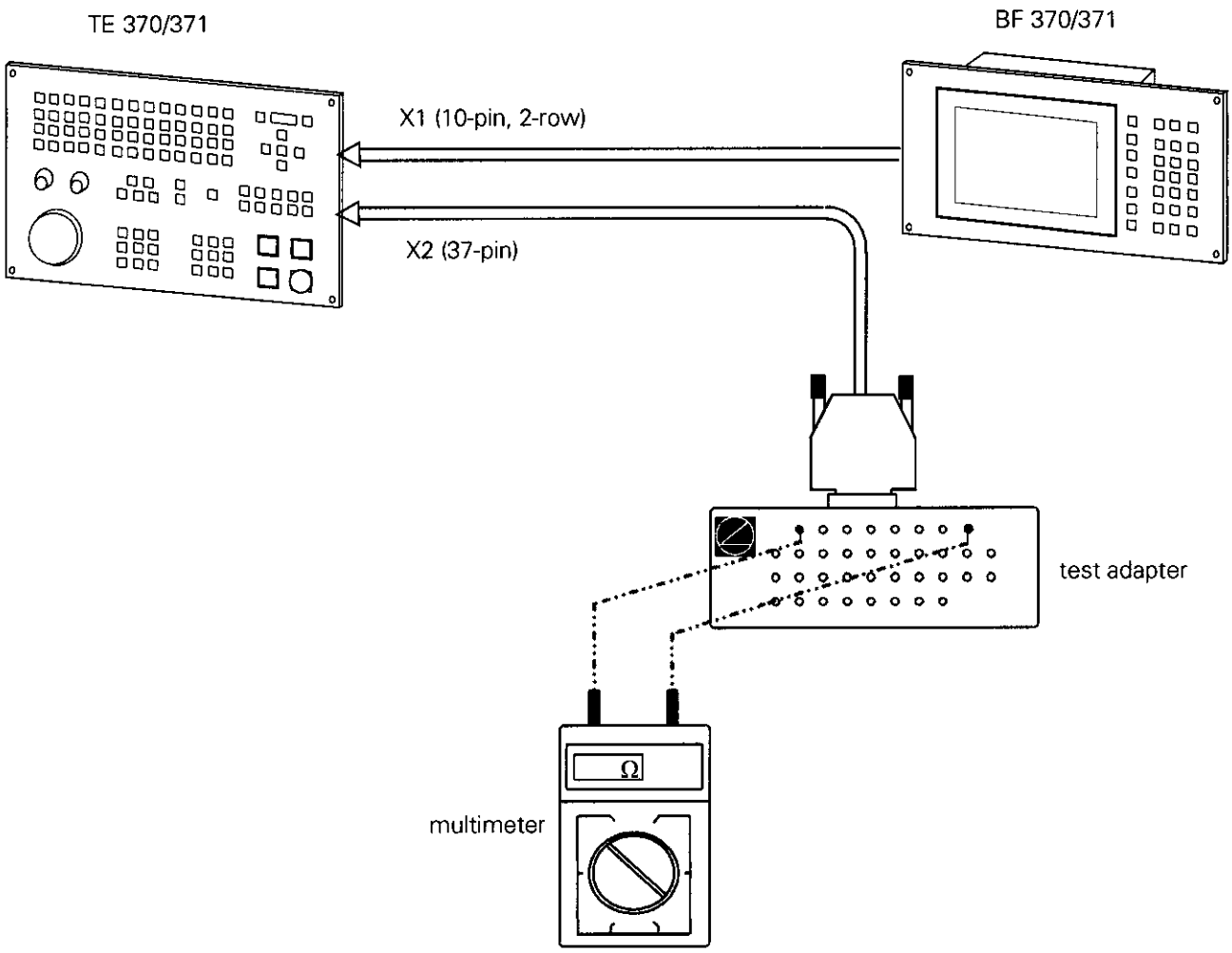
Proceeding:

Observe the safety instructions!

- Switch off the main switch.
- Disconnect the keyboard unit from the LE and connect the measuring adapter (see section 20) to the keyboard unit.
  Now the contacts of the keys can be measured at the measuring adapter with an Ohmmeter.

If e.g. PGM NR is pressed at the TNC operating panel, approx. 1 Ω can be measured at the adapter between PIN 8 and PIN 24 (see key matrix, section 11.2.3 and 11.2.4); consider the resistance of the testing wires.

11.2.2 Measuring Setup to Check the Functions of the NC-Keys



Notes

11.2.3 Key Matrix of the Keyboard Unit

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
!										X							X							
#										X								X						
$											X						X							
%											X							X						
^												X					X							
&												X						X						
*													X				X							
(													X					X						
)														X			X							
−														X				X						
+															X		X							
=															X			X						
√																X	X							
"										X								X						
Q										X										X				
W											X								X					
E											X									X				
R												X							X					
T												X								X				
Y													X						X					
U													X							X				
I														X					X					
O														X						X				
P															X				X					

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
<															X					X				
RET																X			X					
CTRL										X											X			
A										X												X		
S											X										X			
D											X											X		
F												X									X			
G												X										X		
H													X								X			
J													X									X		
K														X							X			
L														X								X		
;															X						X			
>															X							X		
:																X					X			
SPACE										X													X	
Z										X														X
X											X												X	
C											X													X
V												X											X	
B												X												X
N													X										X	
M													X											X
,														X									X	
.														X										X
?															X								X	

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
/															X									X
SPACE																X							X	
PGM MGT								X													X			
	X																						X	
			X																					X
					X																		X	
	X																							X
		X																					X	
			X																				X	
				X																			X	
CHF									X											X				
								X												X				
CR							X													X				
RND							X												X					
CT								X											X					
CC						X														X				
					X															X				
NO ENT		X																				X		
ENT	X																					X		
END	X																X							
								X														X		
						X																X		
						X																	X	
GOTO							X															X		
								X															X	

11.2.4 Key Matrix of the VDU Keys

X1 Pin [1]	9a	10a	1b	2b	3b	4b	5b	6b	7b	8b	1a	2a	3a	4a	5a	6a	8a
X2 Pin [1]	1	2	3	4	5	6	13	14	15	16	20	21	22	23	24	25	27
Key [2]	RL0	RL1	RL2	RL3	RL4	RL5	RL12	RL13	RL14	RL15	SL0	SL1	SL2	SL3	SL4	SL5	SL7
△										X		X					
SK1									X			X					
SK2								X				X					
SK3							X					X					
SK4										X			X				
SK5									X				X				
▽									X					X			
○							X				X						
7			X												X		
4			X											X			
1			X										X				
0		X										X					
CE					X											X	
DEL				X												X	
MOD		X															X
8		X													X		
5		X												X			
2		X											X				
.			X										X				
P				X													X
+			X													X	

[1] connector on keyboard unit
[2] VDU key

X1: connector for flat cable "VDU ⇨ keyboard unit" (plug-type connector, 2 x 10-pin)
X2: connector for cable "keyboard unit ⇨ logic unit" (D-SUB, 37-pin)

SK = **s**oft **k**ey (SK1...SK5 from top to bottom)

X1 Pin [1]	9a	10a	1b	2b	3b	4b	5b	6b	7b	8b	1a	2a	3a	4a	5a	6a	8a
X2 Pin [1]	1	2	3	4	5	6	13	14	15	16	20	21	22	23	24	25	27
Key [2]	RL0	RL1	RL2	RL3	RL4	RL5	RL12	RL13	RL14	RL15	SL0	SL1	SL2	SL3	SL4	SL5	SL7
HELP						X							X				
9	X														X		
6	X													X			
3	X												X				
–	X											X					
I					X												X
Q			X								X						

[1] connector on keyboard unit
[2] VDU key

X1: connector for flat cable "VDU ⇨ keyboard unit" (plug-type connector, 2 x 10-pin)
X2: connector for cable "keyboard unit ⇨ logic unit" (D-SUB, 37-pin)

11.2.5 Checking the Potentiometers

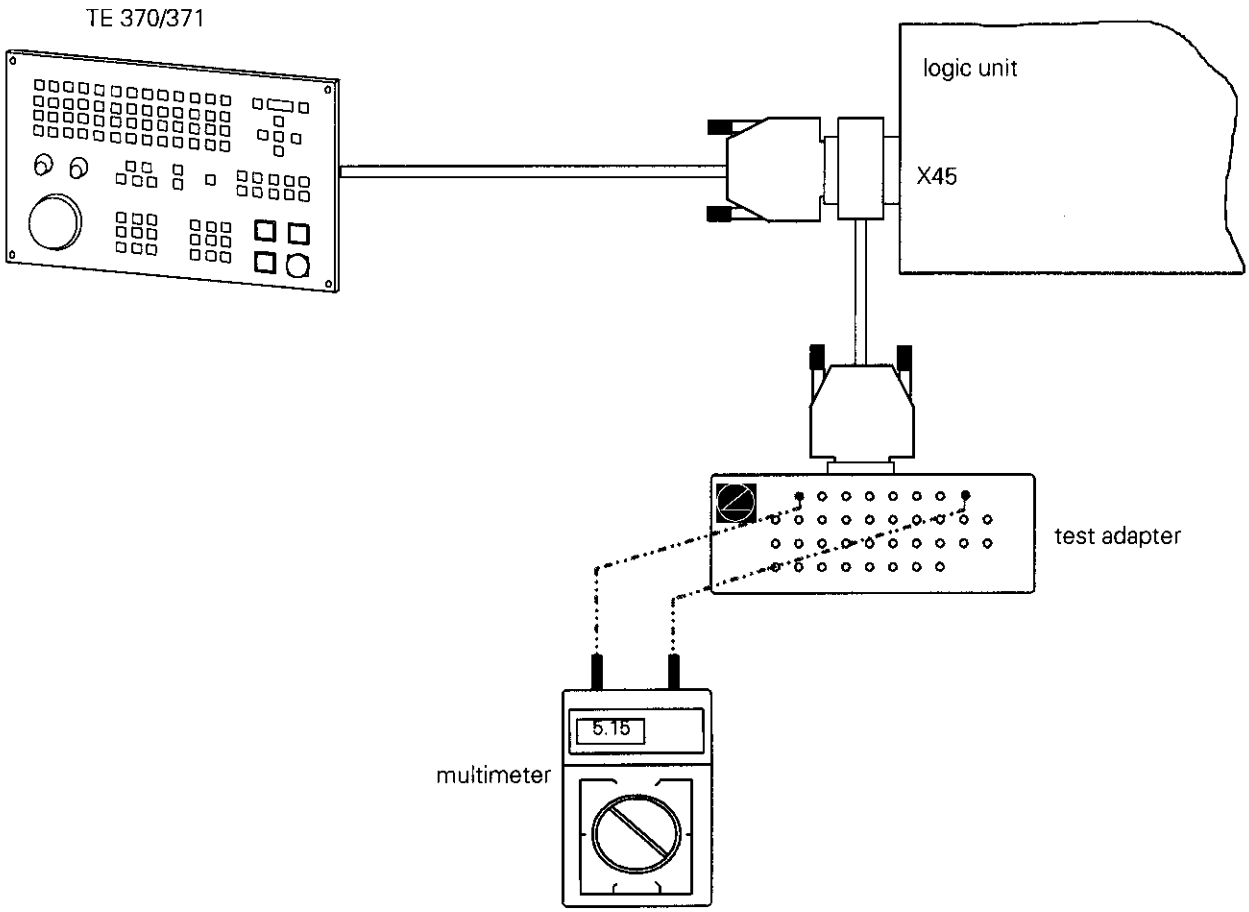
Proceeding:

Observe the safety instructions!

Connect the measuring adapter at X45 of the logic unit. Now the wiper voltages of the potentiometers can be measured with a multimeter.

Potentiometer	PIN	Voltage
override F%	37 = 0V / 35 = + Pot.	(0 to approx. 4.95)V
spindle S%	37 = 0V / 34 = + Pot.	(0 to approx. 4.95)V

11.2.6 Measuring Setup for Checking the Potentiometers



11.2.7 Machine Operating Panel of TE 370

The PLC inputs of the machine operating panel of TE 370 (I128 - I151) can be tested at the flange socket X3 (37-pin) on the keyboard unit TE 370 or at the flange socket X46 (connection of machine control panel) of the TNC 370.

For this purpose the TABLE function (see section 19.4) in the PLC mode is helpful as well.

KEY	Flange socket X3 on KEYBOARD UNIT PIN	PLC Input
X+	11	I138
X−	6	I133
Y+	10	I137
Y−	7	I134
Z+	9	I136
Z−	8	I135
IV+	12	I139
IV−	13	I140
	14	I141

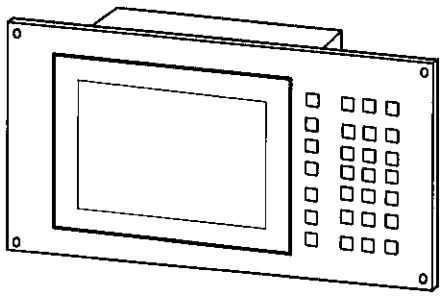
KEY	Flange socket X3 on KEYBOARD UNIT PIN	PLC Input
	15	I142
	3	I130
	1	I128
	2	I129
FN 1	21	I148
FN 2	22	I149
FN 3	23	I150
FN 4	24	I151
FN 5	20	I147
NC STOP	4	I131
NC START	5	I132

PIN 36/37 = +24V PLC supply for the inputs I128 to I151

12. Visual Display Unit BF 370/371

12.1 Overview

BF 370/371 Id.No. 288 708 ..



12.2 Checking the Visual Display Unit BF 370/371

Basic Proceeding:

If the flat screen remains dark when the TNC is switched on, first check the external +24V- power supply (see section 8.1) of the VDU at the 2-pin terminal strip. If the voltage supply is functioning properly, disconnect the cable TNC ⇔ BF from the BF. Then check with an oscilloscope, whether the signals are pending at the corresponding signal lines. If one or several signals are missing **entirely**, disconnect the connecting cable from the TNC and check the signal lines for interruptions and short-circuits. If the connecting cable is in order, the processor board is probably defective.
If however, there are signals pending at the signal lines, the defect **cannot** be located (BF or processor board) without special testing equipment.

13. Encoders

13.1 Error Messages

ENCODER <AXIS> DEFECTIVE A

A = signal amplitude error

ENCODER <AXIS> DEFECTIVE B

B = edge separation

ENCODER <AXIS> DEFECTIVE C

C = error with distance-coded scales

13.1.1 Error Causes

- Glass scale contaminated or damaged
- Scanning head contaminated or defective
- Cable damaged
- Encoder input of the logic unit (LE) defective

13.1.2 Error Location

In order to determine whether the encoder or the encoder input of the logic unit is defective, the encoders can be switched at the logic unit. For this purpose the corresponding machine parameters must be altered as well:

Function		MP	Entry value
Allocation of the axes	X	110.0	0 = X1
to the encoder inputs	Y	110.1	1 = X2
	Z	110.2	2 = X3
	IV	110.3	3 = X4
			4 = no function
			5 = X6[1)]

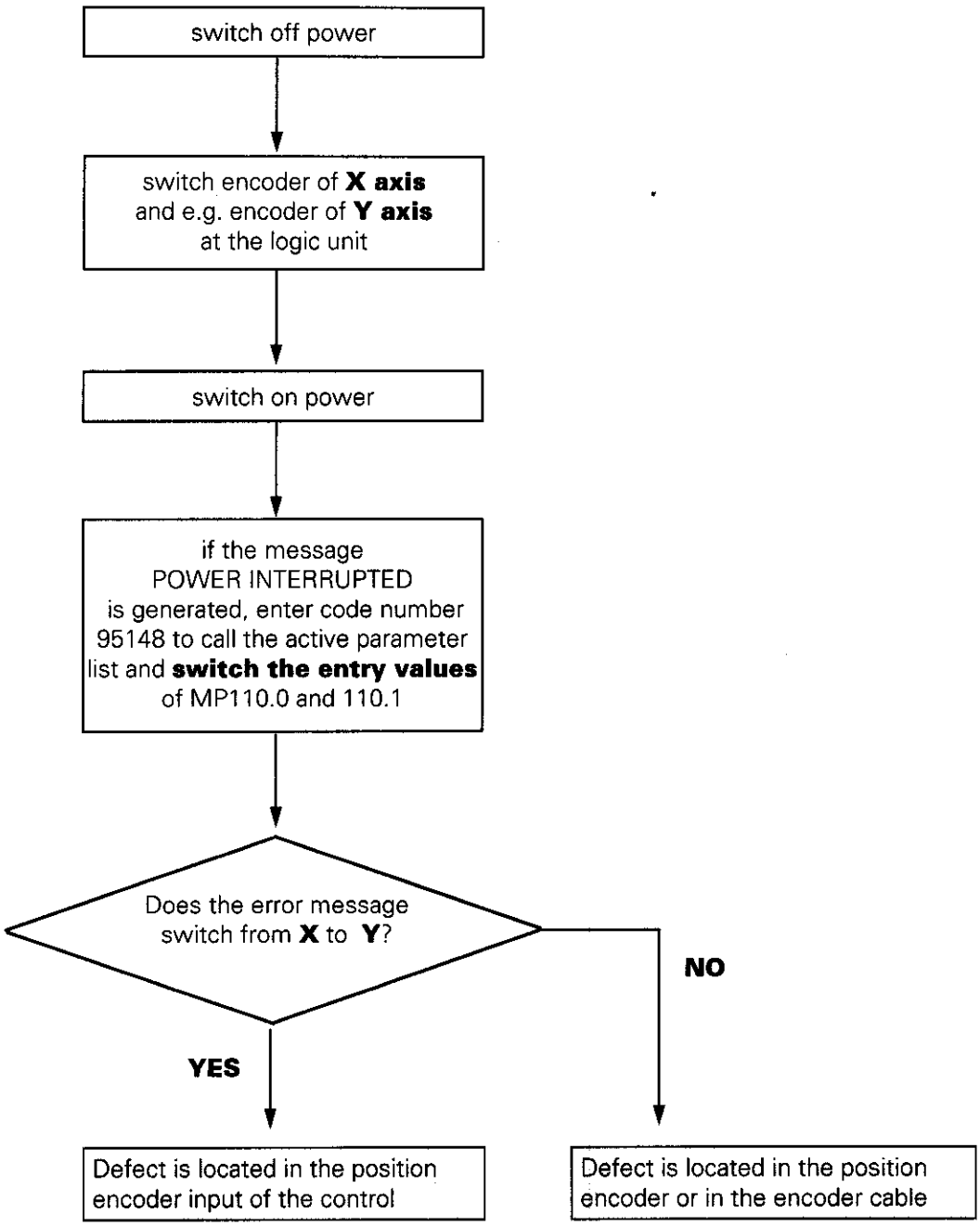
1) X6 may be used for a machine axis, if no oriented spindle stop is required.

NOTES

Flow-Chart for Error Location

ENCODER X DEFECTIVE B

(Example)



Observe the safety instructions!

13.2 Electrical Inspection of an Encoder

In order to give a precise statement on the electrical function of an encoder, it must be measured with a phase angle measuring unit (PWM), an oscilloscope and a leak tester. (see operating instructions of encoder diagnostic set)

If no phase angle measuring unit is available, the electrical state of the cable, the lamp and the photocells of an encoder can be checked with an ohmmeter. The following resistances must be measured at the connector of the encoder:

Possible measurements at an encoder with current interface (7 - 16µA)

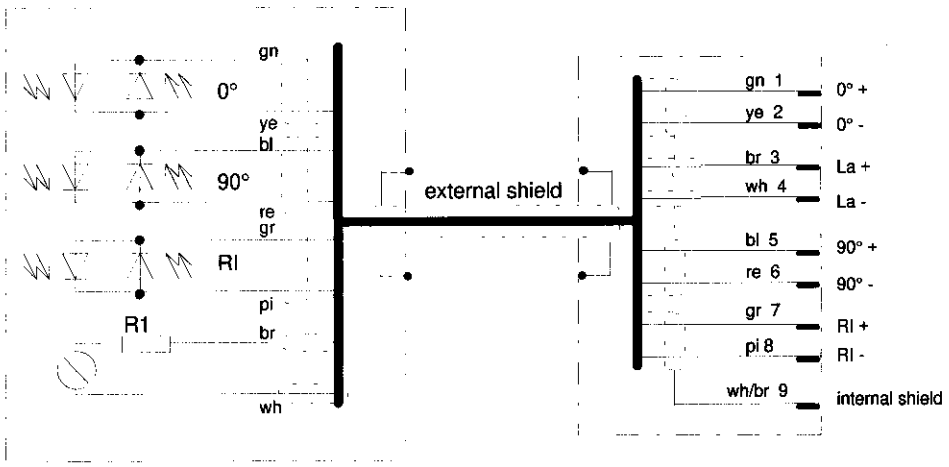
- encoder connector housing against machine chassis < 1 Ω (external shield)
- encoder connector housing against PIN 9 (internal shield - external shield) R = ∞
- encoder connector housing against PIN 1 to PIN 8 (external shield - signal lines) R = ∞
- PIN 9 against PIN 1 to PIN 8 (internal shield - signal line) R = ∞

• pin 1 against pin 2	0°		
• pin 2 against pin 1	0°	(switch poles of ohmmeter)	
• pin 5 against pin 6	90°		The measured values should approximately equal.
• pin 6 against pin 5	90°	(switch poles of ohmmeter)	
• pin 7 against pin 8	RP[1]		
• pin 8 against pin 7	RP[1]	(switch poles of ohmmeter)	
• pin 3 against pin 4[2]		(approx. 5 - 30 Ω)	

[1] If encoders with selectable reference mark are used, different resistance values can be measured (or no resistance), depending on the type of activation.

[2] The encoder check (pin 3 against pin 4) can only be carried out, if the encoder light unit is a lamp. If the encoder features an amplifier section, the light unit cannot be checked at all. With encoders with infrared diodes, a resistance in the conducting direction can be measured between pin 3 (+) and pin 4 (-).

Basic Circuit Diagram with Sinusoidal Signals (7 - 16µA)



Encoders with square-wave signals can only be tested with a phase angle measuring unit (PWM).

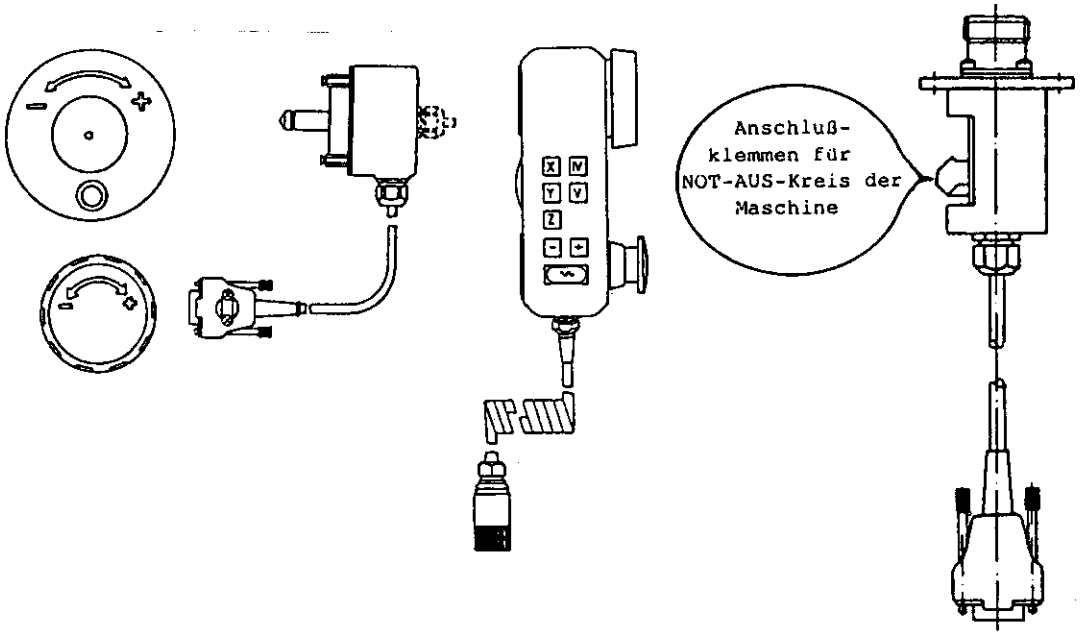
14. Electronic Handwheels

14.1 Handwheel HR 130/330

HR 130 Id.No. 254 040 –
HR 130.001 Id.No. 249 371 –

HR 330 Id.No. 251 534 –

Adapter cable for HR 330 Id.No. 249 889 –

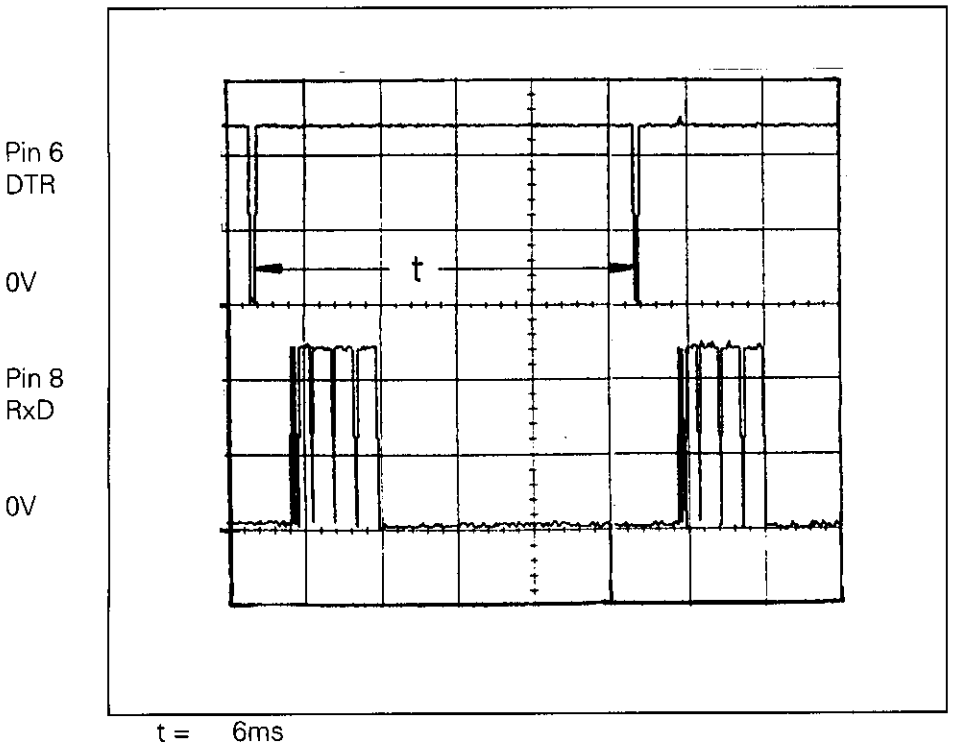


Pin	Color	Sig.
1	bl	EMG.
2	bl	STOP
3	gn	RxD
4	ye	DTR
5	bn	+12V
6	wh	0V

Pin	Color	Sig.
2	wh	0V
4	bn	+12V
6	ye	DTR
8	gn	RxD

14.1.1 Checking the Handwheel HR 130/330

The serial handwheel HR 130 (without auxiliary keys) and HR 330 (with auxiliary keys) can be checked with an oscilloscope. The following signals can be measured at the handwheel input X23 of LE 415B/425. The signals must correspond to the diagram below.



t = 6ms

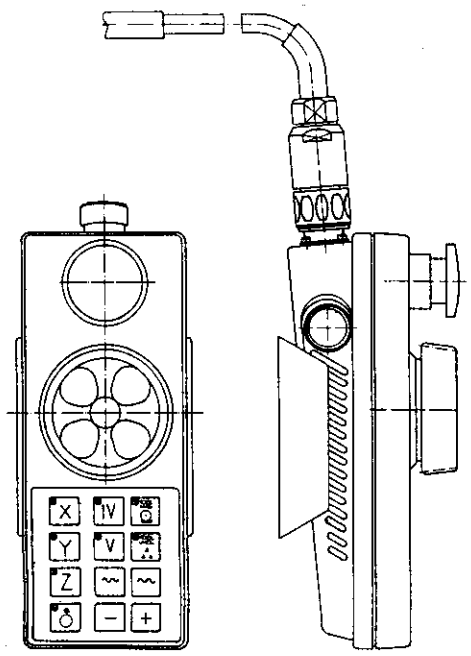
The supply voltage for the handwheel is fed via the logic unit (X23 pin 2 = 0V, pin 4 = + 12V).

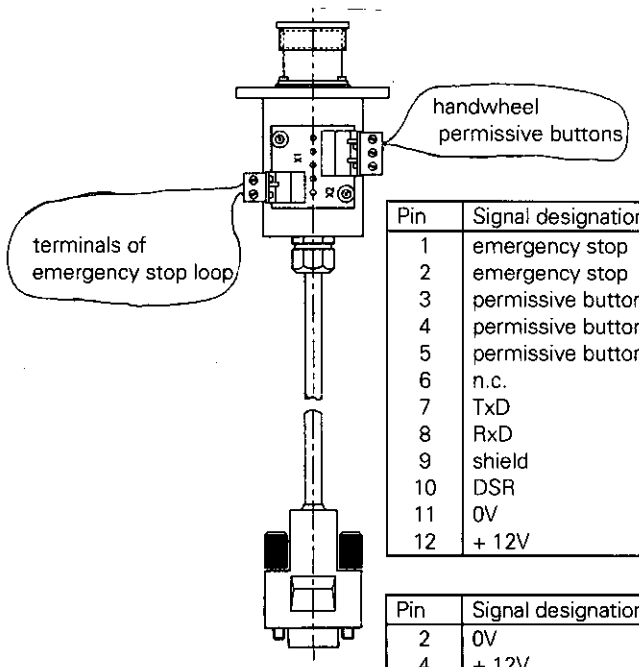
14.2 Handwheel HR 332

HR 332
Id.No. 266 064 --

Connecting cable
Id.No. 272 292 –

Adapter cable Id.No. 274 556 01
(12-pin to 9-pin)





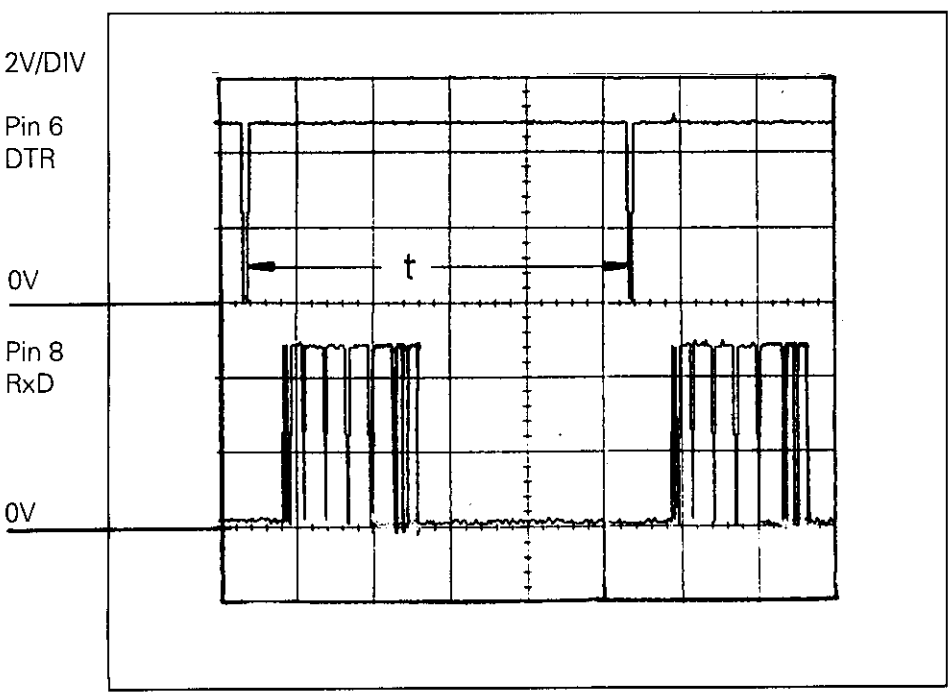
Pin	Signal designation
1	emergency stop
2	emergency stop
3	permissive button[1)]
4	permissive button[1)]
5	permissive button[1)]
6	n.c.
7	TxD
8	RxD
9	shield
10	DSR
11	0V
12	+ 12V

Pin	Signal designation
2	0V
4	+ 12V
6	DTR
7	TxD
8	RxD

The assignment of the handwheel keys depends on the version.
[1)] The number of the permissive buttons and the internal wiring depends on the version of HR 332.

14.2.1 Checking the Handwheel HR 332

The serial handwheel HR 332 can be checked with an oscilloscope. The following signals can be measured at the handwheel input X23 of LE 415B/425. The signals have to correspond to the diagram below.



t = 6ms

The supply voltage for the handwheel is fed via the logic unit (X23 pin 2 = 0V, pin 4 = + 12V).

14.3 Error Messages

HANDWHEEL?

- Data transfer (cable) has been interrupted
- Incorrect value entered in MP 7640.

HANDWHEEL DEFECTIVE

The light unit in the electronic handwheel is not emitting enough light, with the result that the signals in the handwheel become too small. An error signal is sent over the serial interface of the handwheel.

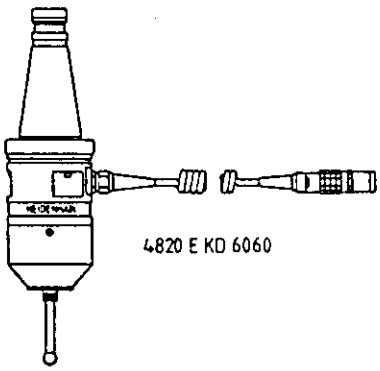
HANDWHEEL NOT READY X

X =	A	: no peripheral unit connected
	B	: code of peripheral unit and MP7640 do not match
	C Y	: contamination (Y = axis)
	D	: transmission error (receipt)
	E	: incorrect BCC check sum received
	F	: peripheral unit has received wrong code
	G	: peripheral unit has received wrong BCC check sum
	H	: transmission error from peripheral unit
	I	: wrong number of initializing parameter from peripheral unit
	J	: wrong value of initializing parameter peripheral unit

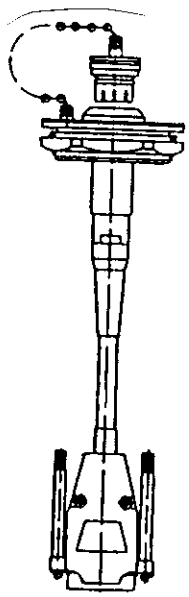
15. 3D-Touch Probes

15.1 Overview

TS 120 Id.No. 243 614 –



Adapter cable for TS 120 Id.No. 244 891 –



15.2 Error Messages

15.2.1 Error Messages in the Probing Mode

TOUCH POINT INACCESSIBLE

- After the start of a probing function, the scanning point was not reached within the measuring range defined in the machine parameter MP6130.

EXCHANGE TOUCH PROBE BATTERY

- The battery voltage of the touch probe system with infrared transmission is below the minimum value.

STYLUS ALREADY IN CONTACT

- The stylus was already deflected when the probing function was started.

PROBE SYSTEM NOT READY

- The infrared transmission between the "Touch Probe" and the "Transmitter/Receiver Unit" is faulty (e.g. caused by contamination) or interrupted. The two windows of the touch probe system must be oriented to the transmitter/receiver unit.
- The battery is dead.
- Check whether the touch probe is ready for operation.

15.2.2 Error Messages during Digitizing of 3D-Contours

AXIS DOUBLE PROGRAMMED

Two different axes must be programmed for the coordinates of the starting point (cycle CONTOUR LINES).

START POSITION INCORRECT

In the cycle CONTOUR LINES the coordinates of the starting point must be programmed such that they are within the RANGE.

TOUCH POINT INACCESSIBLE

- The stylus must not be deflected before the RANGE is reached.
- The stylus must be deflected in the RANGE.

RANGE EXCEEDED

Enter the RANGE for the entire 3D-contour.

FAULTY RANGE DATA

- The MIN coordinates must be smaller than the corresponding MAX coordinates.
- The RANGE must be defined within the software limit switch range.
- Define the RANGE for the cycles MEANDER and CONTOUR LINES.

ROTATION NOT PERMITTED

Reset the conversion of the coordinates before starting the digitzing function.

PLANE WRONGLY DEFINED

The coordinates of the starting point in the cycle CONTOUR LINES must be different from the touch probe axis.

WRONG AXIS PROGRAMMED

Enter the calibrated touch probe axis in the RANGE cycle.

SCALING FACTOR NOT PERMITTED

Reset the conversion of the coordinates before starting the digitzing function.

MIRRORING NOT PERMITTED

Reset the conversion of the coordinates before starting the digitzing function.

EXCHANGE TOUCH PROBE BATTERY

Exchange the battery in the touch probe head.
This message is generated at the end of a line.

STYLUS ALREADY IN CONTACT

The stylus must be prepositioned such that it is not deflected outside the RANGE.

PROBE SYSTEM NOT READY

- The two windows of the TS 511 must be oriented to the receiver unit.
- Check whether the touch probe is ready for operation.
- The touch probe cannot be disengaged (undercuts).

DATUM SHIFT NOT PERMITTED

Reset the conversion of the coordinates before starting the digitizing function.

TIME LIMIT EXCEEDED

The TIME LIMIT and the 3D-contour must correspond to each other (cycle CONTOUR LINES).

16. Data Interfaces

16.1 Operating Modes of the Data Interfaces

For data transfer the TNC 370 can be switched to the following 3 interface modes:

ME: For connection of the HEIDENHAIN Magnetic Tape Unit ME 101/102 or other peripheral units (e.g. printer).

Data format and protocol adapted to ME!

Protocol:	standard transfer
Data format:	7 data bits, 1 stop bit, even parity
Baud rate:	110 - 2400 Baud
Interface parameter:	fixed
Transmission stop:	DC3 (software handshake)

FE: For connection of the HEIDENHAIN Floppy Disk Unit FE 401 B (or the Floppy Disk Unit FE 401, from software 230 626 **03**) or other peripheral units.

Data format and protocol adapted to FE 401/B!

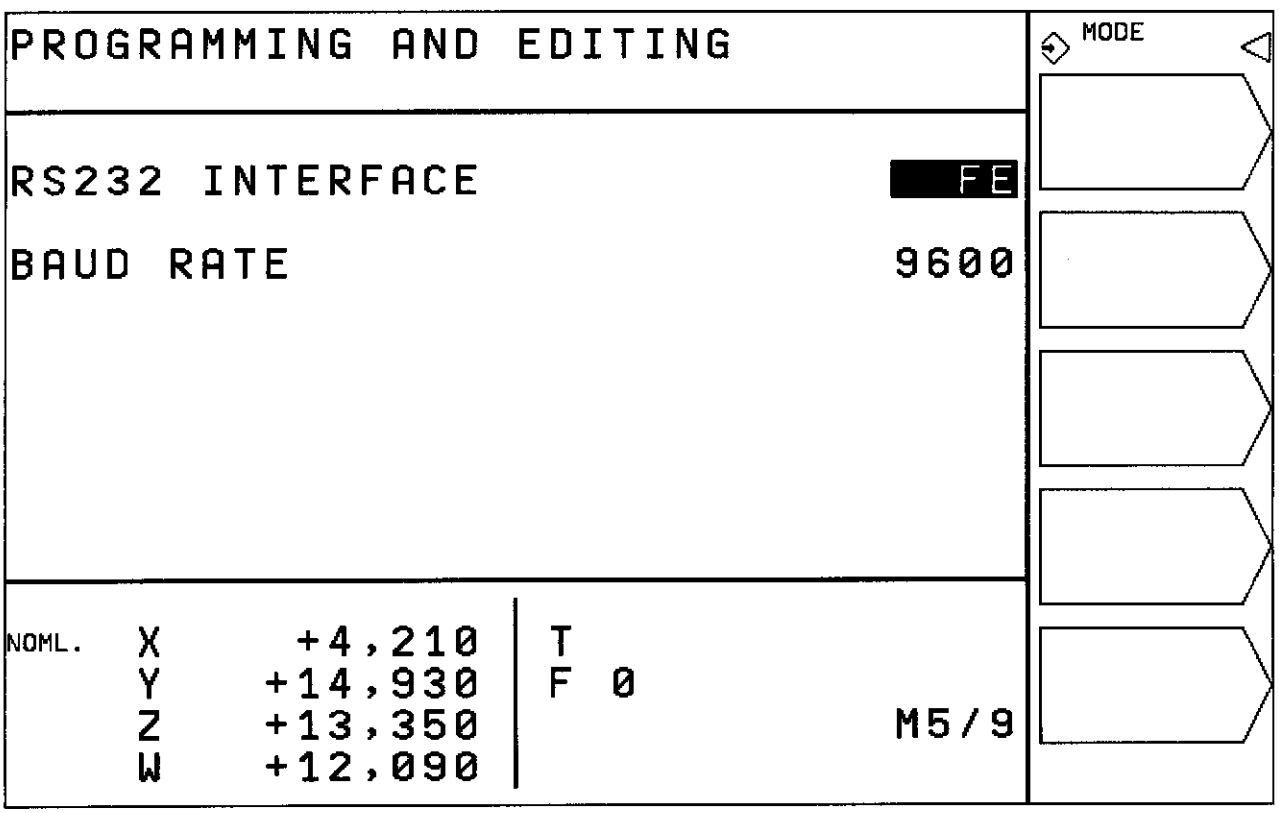
Protocol:	blockwise transfer
Data format:	7 data bits, 1 stop bit, even parity
Baud rate:	110 - 38400 Baud (FE 401B) 9600 Baud (FE 401)
Interface parameter:	fixed
Transmission stop:	DC3 (software handshake)

EXT: To adapt the transfer of data to external units in standard data format and for blockwise transfer.

Protocol:	standard or blockwise transfer adaptation from machine parameter MP 5000
Data format:	adaptation from machine parameter MP 5000
Baud rate:	110 - 38400 Baud
Interface parameters :	adaptation from machine parameter MP 5000
Transmission stop:	DC3 (software handshake) or RTS (hardware handshake) selectable as of MP5000

16.1.1 Interface Configuration and Allocation of the Operating Modes

Press key	Function
	Select any operating mode
	Call the MOD function
	Activate the SETUP for the data interface



[2_I.PCX]

With the arrow keys and the desired settings (operating mode and baud rate) can be selected and set according to your requirements by pressing .

	Exit the MOD-function RS 232 SETUP

16.2 Machine Parameters for the Data Interfaces

In the operating modes ME and FE the interface parameters **cannot** be changed.

In the operating modes EXT the interface parameters can be set via machine parameter (starting with MP5000).

Please see the detailed functions of the individual machine parameters from the "Technical Manual".

16.3 Error Messages

16.3.1 Error Messages at the TNC in the ME Mode

WRONG OPERATING MODE

The wrong operating mode or no operating mode was selected on the external data medium.

WRONG PROGRAM DATA

Wrong program data have been detected during data transfer. The control attempted three times to read the data from the magnetic tape before interrupting the process.

DATA MEDIUM MISSING

No cassette has been inserted into the drive.

DATA MEDIUM EMPTY

No programs are stored on the data medium (cassette).

DATA MEDIUM WRITE-PROTECTED

The write-enable plug on the cassette is missing.

EXT. INPUT/OUTPUT NOT READY

The DSR-signal is missing at the TNC.
- ME not connected.
- Defective or wrong transfer cable.
- Wrong interface assignment.

ME: TAPE END

The cassette is full. To continue data transfer, turn over or exchange the cassette.

16.3.2 Error Messages at the ME

In the ME the electronics is tested, and the external operating conditions are checked. If an error is detected, the lamps of the operating mode display start blinking. In the following table the error types are listed:

○ LED off ✱ LED blinking

Indicator lamps	Error message
○○○✱ ○○○○	Faulty data during transfer
○○✱○ ○○○○	No cassette inserted
○○✱✱ ○○○○	Write-enable plug in cassette missing
○✱○○ ○○○○	Wrong operating mode selected
○✱○✱ ○○○○	Data of magnetic tape faulty
○✱✱○ ○○○○	Magnetic tape empty
✱○○○ ○○○○	Errors in ME electronics
✱○○✱ ○○○○	
✱○✱○ ○○○○	
✱○✱✱ ○○○○	
✱✱○○ ○○○○	
✱✱○✱ ○○○○	
✱✱✱✱ ○○○○	End of tape
○✱✱✱ ○○○○	Peripheral unit not connected
✱✱✱○ ○○○○	Data transfer between TNC and ME or peripheral unit was interrupted with DEL

By pressing STOP the error messages can be cleared.

16.3.3 Error Messages at the FE in the ME-Mode

In the ME-mode, errors are displayed by blinking indicator lamps (LEDs).

○ LED off ● LED on ✸ LED blinking

Indicator lamps	Error message
○○○● ○✸○○	Disk missing or error in the ME electronics
○○○✸ ○✸○○	Disk cannot be formatted, as it is currently being used
✸○○● ✸○○○	Disk missing or not formatted
✸○○✸ ✸○○○	Disk cannot be copied, as a read/write process is active
●○✸● ○○○○	External unit not ready or not connected
✸○●● ○○○○	Disk missing or not formatted
✸○○● ○○●○	Disk missing or not formatted or no program available
✸○●✸ ○○○○	Program cannot be output, as a transfer is active via the TNC interface
✸○○✸ ○○●○	Program cannot be output, as a transfer is active via the PRT interface
○○✸● ●○○○	External unit not ready or not connected
○○●● ✸○○○	Disk missing or not formatted
○○○● ✸○●○	Disk missing or not formatted
○○●✸ ✸○○○	Program cannot be output, as a transfer is active via the TNC interface
○○○✸ ✸○●○	Program cannot be output, as a transfer is active via the PRT interface
○●○● ○○✸○	External unit not ready or not connected
○✸○● ○○●○	Disk missing or error in the ME electronics
○✸○✸ ○○●○	Table of contents cannot be output, as a transfer is active via the PRT interface
○○○✸ ○○●○	No interface coupling possible, as a transfer is active via the TNC interface
○○●✸ ○○○○	No interface coupling possible, as a transfer is active via the PRT interface
○○✸● ○○○○	External unit not ready or not connected

By pressing STOP the error messages can be cleared.

16.3.4 Error Messages at the TNC in the FE-Mode

In this operating mode, the floppy disk unit outputs errors in the following format:

(SOH) **ERR**: (SP) (SP) (SP) **[XXX]** (ETB) (BCC)
XXX = error number

Overview of the error messages:

Input/Output Errors

ERR: 001 = wrong command code
ERR: 002 = illegal program name
ERR: 003 = faulty data transferred
ERR: 004 = program incomplete
ERR: 005 = receiving buffer overflow
ERR: 006 = function currently disabled
ERR: 007 = data buffer overflow

Errors during Program Write or Read

ERR: 010 = program not on disk
ERR: 011 = program erase-protected
ERR: 012 = program is being written to
ERR: 013 = program directory is full
ERR: 014 = disk is full
ERR: 015 = text not found
ERR: 016 = program name already exists
ERR: 017 = disk access active
ERR: 018 = program currently being read

Disk / Controller / Drive Errors

ERR: 100 = disk not initialized
ERR: 101 = sector number too large [1]
ERR: 102 = drive not ready [2]
ERR: 103 = disk is write-protected
ERR: 104 = faulty data on disk [1]
ERR: 105 = sector cannot be found [1]
ERR: 106 = check sum incorrect [1]
ERR: 107 = disk controller defective [3]
ERR: 108 = DMA defective [3]
ERR: 109 = disk exchanged during program loading

[1] These error messages indicate that the disk is defective; in most cases, they can only be eliminated by formatting the disk anew.

[2] If this error message comes up while the disk is inserted, the drive is probably defective.

[3] Hardware defect

16.3.5 Error Messages during Data Transfer

FILENAME NOT PROGRAM NAME

- The filename of the NC program and the name indicated in the program are not identical.

ENTRY VALUE INCORRECT

- The control requires more machine parameters than are available on the external data medium.
- One or more machine parameters on the external data medium contain a non-permissible value.

EXT. IN-/OUTPUT NOT READY

- DSR signal at the TNC missing.
- FE not connected.
- Defective or wrong transfer cable.

PROGRAM DATA ERRONEOUS

- Faulty program data have been detected during data transfer.

PROTECTED FILE!

- An attempt was made to overwrite a file that is protected by means of a "read only" or "hidden" attribute.

ILLEGAL COMMAND

- The request command output by the control is not permissible.

PROGRAM NOT FOUND

- The file requested by the control is not stored in the current directory.

PROGRAM INCOMPLETE

- The NC program does not contain an END block.

SEARCH ADDRESS MISSING

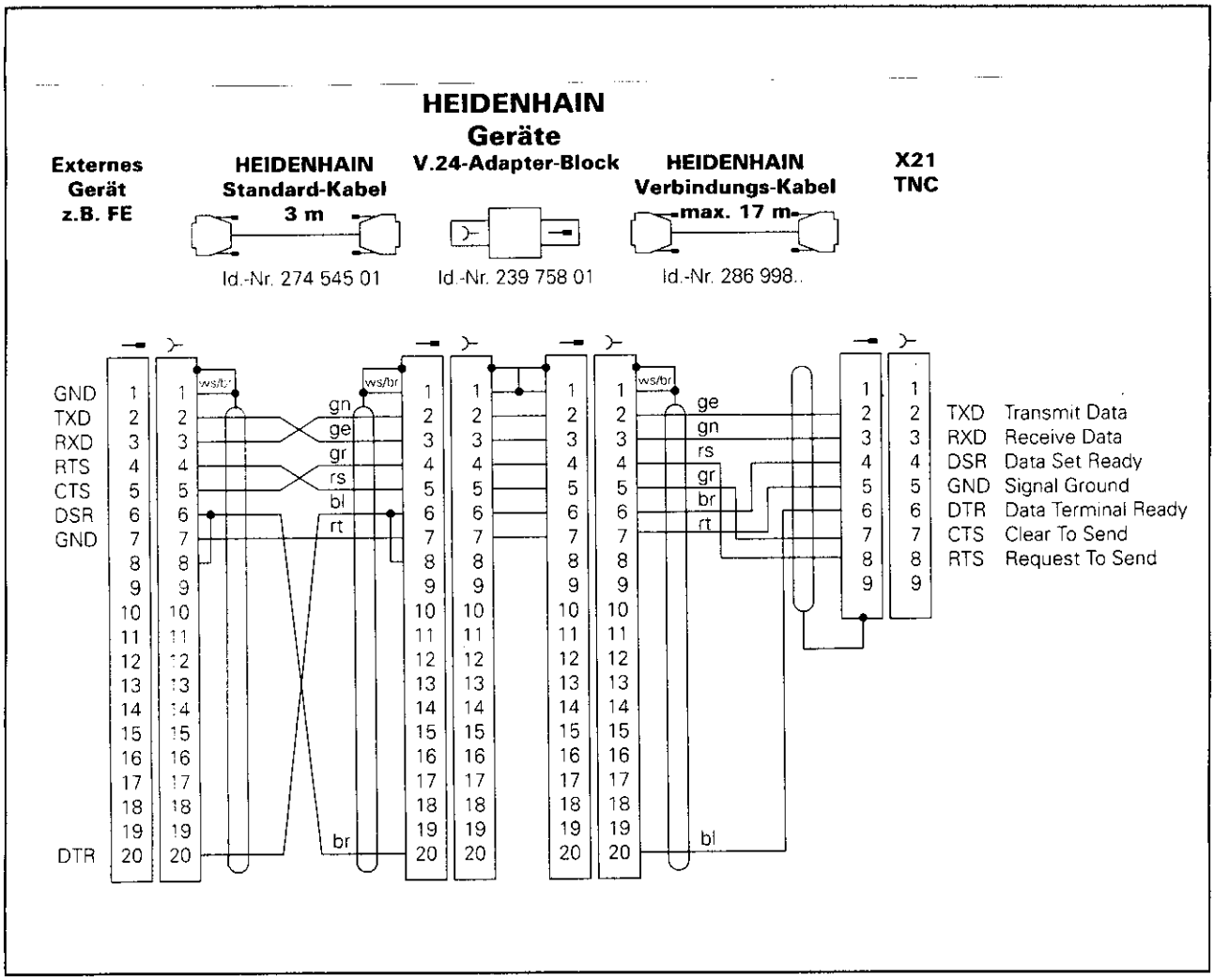
- The search address is not a permissible character.

TRANSFERRED VALUE ERRONEOUS X

X =
- A faulty character frame
- B character overrun
- C faulty character frame or character overrun
- D parity error
- E faulty character frame or parity error
- F character overrun or parity error
- G faulty character frame or character overrun or parity error
- H receiving-buffer overflow
- M control has received the character for "negative acknowledgement" (NAK) more than 3 times
- N control has sent the character for "negative acknowledgement" (NAK) more than 3 times
- P time out

16.4 Wiring Diagram of the Data Interfaces

16.4.1 V.24/RS-232-C Data Interface with V.24-Adapter Block (full wiring)



If the pin layout of your peripheral unit differs from the above layout, the HEIDENHAIN connecting cable may not be used.

The pin layouts of the Die RS-232-C-/V.24 data interface are **not identical** at X21 (logic unit) and at the RS-232-C adapter block.

17. Data Input and Output

17.1 Overview of Files for TNC 370

The following data may be in RAM:

NC Memory Management	Extension (TNC)	Extension (external)
NC program: HEIDENHAIN language	.H	.H
NC program: ISO	.I	.D
Tool table	TOOL.T	TOOL.T
Pocket table	TOOLP.TCH	TOOLP.R
PLC program		.P
Machine parameter list		.M
Multipoint axis error compensation (Gerber)		.S

Additional information on the files or programs is provided by letters in the status field.

M: The file/program has been selected and activated in either PROGRAM RUN / FULL SEQUENCE or in PROGRAM RUN / SINGLE BLOCK.
P: The file/program is protected against erasing and editing.

17.2 Data Output

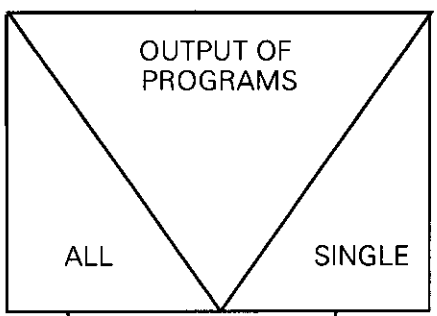
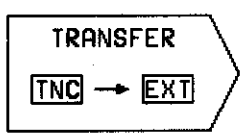
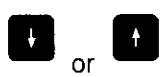
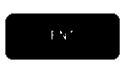
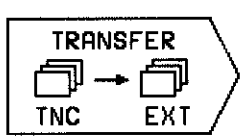
Preparations:

- Connect the external data medium (ME, FE or other peripheral unit, e.g. PC with HEIDENHAIN data transfer software) to the TNC.
- Prepare the external data medium for data transfer:

  Press STOP, INC and →9 at the ME

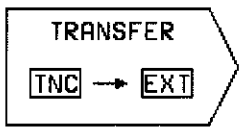
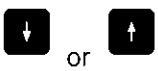
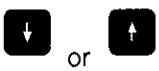
  Press STOP at the FE.
- Select the operating mode and the baud rate (see section 16.1) at the TNC.

17.2.1 Output of Files with the Extensions .H, .I

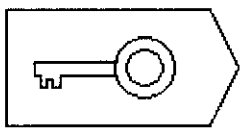
Press key	Function
	Operating mode PROGRAMMING/EDITING
	Call directory
	Activate data transfer menu
	
	Output mode SINGLE
	Select the file to be output by pressing the cursor keys or by entering a file name after FILE NAME =
	Program is output
	All programs are output

If the external data medium already contains programs with the same names, these programs are **overwritten**!

17.2.2 Output of the Files TOOL.T (Tool Table) and TOOLP.TCH (Pocket table)

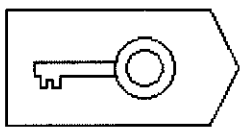
Press key	Function
	Operating mode PROGRAMMING AND EDITING
	Call file directory
	Activate data transfer menu
	Output mode SINGLE
	Press the arrow keys to select the file TOOL.T
	Start data output; the tool table is stored as **TOOL.T** on the external data medium
	Press the arrow keys to select the file TOOLP.TCH
	Start data output; the pocket table is stored as **TOOLP.R** on the external data medium
	Return to main menu

17.2.3 Output of the Machine Parameter List

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING
	Call MOD function
	Prepare TNC for input of code number
	Enter code number, confirm with ENT
	Call data transfer menu
FILENAME =	Enter the filename under which the file is stored on the external data medium
	Start data output
	Exit the MP mode

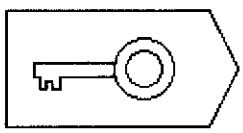
On the external data medium the machine parameter list is stored as <NAME>.**M**.

17.2.4 Output of the Compensation Value Table for Multipoint Axis Error Compensation

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Call MOD function
	Prepare TNC for input of code number
1 0 5 2 9 6 ENT	Enter code number, confirm with ENT
EXT OUT	Activate data transfer menu
FILENAME =	Enter the file name under which the file is stored on the external data medium
ENT	Start data output
END END	Exit the compensation value list

On the external data medium the compensation value table is stored as <NAME>**.S**.

17.2.5 Output of the PLC Program (RAM)

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Call MOD function
	Prepare TNC for input of code number
8 0 7 6 6 7 ENT	Enter code number, confirm with ENT
EXT	Activate data transfer menu

Four output formats are available:

OUTPUT ASCII ⇒ as formatted ASCII file (as in the PLC editor)
OUTPUT ASCII UNFORMATTED ⇒ as unformatted ASCII file (quite confusing)
OUTPUT ASCII WITH CROSS-REFERENCES⇒ as ASCII file with list of cross-references (very helpful for servicing)
OUTPUT BINARY ⇒ only to create an EPROM, **not** to back up data

↑ or ↓	Select the desired output format and confirm with ENT
FILENAME =	Enter the file name under which the file is stored on the external data medium
ENT	Start data output
END END	Exit the PLC mode

On the external data medium the PLC program is stored as <NAME>**.P**.

17.3 Data Input

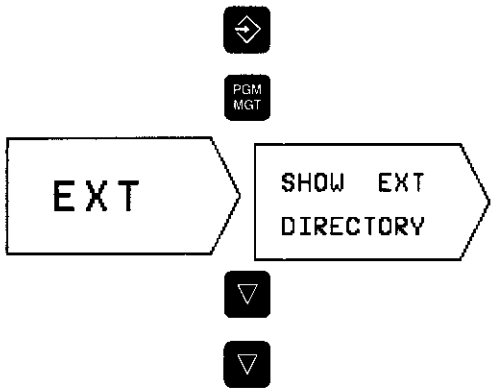
Preparations:

- Connect the external data medium (ME, FE or other peripheral to the TNC.
- Prepare the external data medium for data transfer:

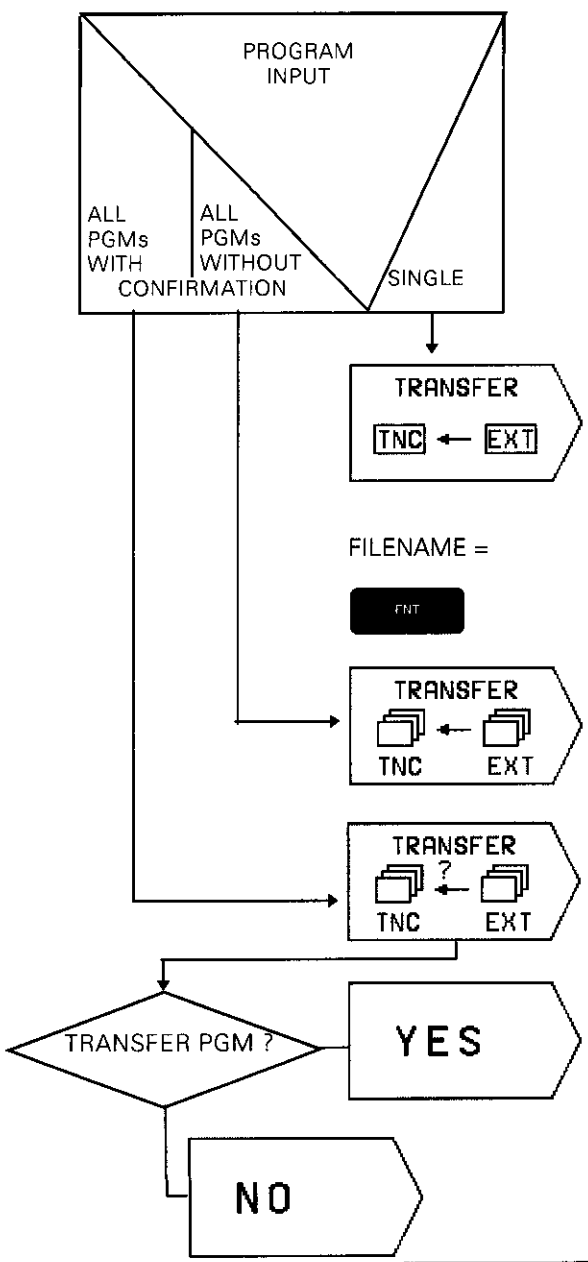
  Press STOP, TNC and →∂ at the ME

  Press STOP at the FE.
- Select the operating mode and the baud rate (see section 16.1) at the TNC.

17.3.1 Input of Files with the Extensions .H, .I

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING Call file directory Activate data transfer menu Call external directory, if required (only possible in FE mode) Return to data transfer menu

Depending on the setting of PROGRAM INPUT xxxx (can be called with MOD) only HEIDENHAIN (.H) or ISO (.I) files can be transferred!



Input mode SINGLE

Enter the file name under which the file is stored on the external data medium

Start data input

All programs on the external data medium are transferred

Input mode ALL with confirmation

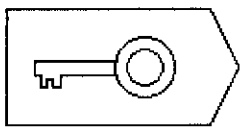
The program is transferred

The program is not transferred

17.3.2 Input of the Files TOOL.T (Tool Table) and TOOLP.TCH (Pocket Table)

Press key	Function
	Operating mode PROGRAMMING AND EDITING
PGM MGT	Call file directory
EXT	Activate data transfer menu
TRANSFER TNC ← EXT	Input mode SINGLE
FILENAME = TOOL	Enter file name **TOOL** for tool table
ENT	Start data input
TRANSFER TNC ← EXT	Input mode SINGLE
FILENAME = TOOLP	Enter file name **TOOLP** for pocket table
ENT	Start data input
END END	Return to main menu

17.3.3 Input of the Machine Parameter List

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Call MOD function
	Prepare TNC for input of code number
9 5 1 4 8 ENT	Enter code number; confirm with ENT
EXT IN	Call data transfer menu
FILENAME =	Enter the file name under which the file is stored on the external data medium
ENT	Start data input
END END	Exit the MP mode

Machine Parameter Input when the error message

OPERATING PARAMETERS ERASED **is displayed**

(see section 2.1)

Press key	Function
OPERATING PARAMETERS ERASED	
CE	Clear message
PLC: PROGRAM MEMORY ERASED	
CE	Clear message
MOD RS 232 SETUP	Call RS 232 SETUP and configure the data interface (see section 16.1.1)
END	Return to MP list
EXT IN	Call data transfer menu
FILENAME =	Enter the file name under which the file is stored on the external data medium
ENT	Start data input

The error message ENTRY VALUE INCORRECT CONTINUE ?

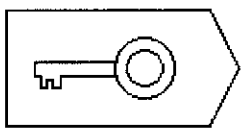
may be generated during data input for the following reasons:

- The external data medium contains fewer machine parameters than are required by the TNC (e.g. after a software exchange).
- The entry value of a least one machine parameter is not permissible (beyond the TNC input range).

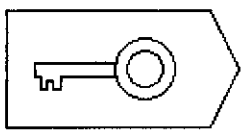
Remedy:

Continue data transfer with YES and enter the missing or incorrect parameters by hand after the transfer. Your machine tool manufacturer will provide information on these machine parameters.

17.3.4 Input of the Compensation Value List for Multipoint Axis Error Compensation

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Call MOD function
	Prepare TNC for input of code number
1 0 5 2 9 6 ENT	Enter code number; confirm with ENT
	Activate data transfer menu
FILENAME =	Enter the file name under which the file is stored on the external data medium
ENT	Start data input
END END	Exit the compensation value list

17.3.5 Input of the PLC Program (RAM)

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Call MOD function
	Prepare TNC for input of code number
8 0 7 6 6 7 ENT	Enter code number; confirm with ENT
EXT	Activate data transfer menu
↓ or ↑	Press arrow keys to select the menu option READ-IN SELECTED PROGRAM
ENT	
FILENAME =	Enter the file name under which the file is stored on the external data medium
ENT	Start data input
END END	Exit the PLC mode

18. Analogue Outputs

18.1 Technical Data

5 outputs 1, 2, 3, 4 and S

Load capacity: $R_{Lmin} \geq 5\ k\Omega$
$C_{Lmax} \leq 2\ nF$

Voltage range: $U_{amax} = 10V \pm 100\ mV$
$U_{amin} = -10V \pm 100\ mV$

Machine parameters for the analogue outputs

Axis	MP	
X	120.0	0 = output 1
Y	120.1	1 = output 2
Z	120.2	2 = output 3
IV	120.3	3 = output 4
		4 = no function
		5 = output S

Resolution	14 bits = 16 304 steps
Smallest step	$\frac{10\ V}{16\ 384} = 0.610\ mV$

18.2 Checking the Analogue Outputs

Proportionally to the traversing speed, the control generates an analogue voltage of 0V to 9V (rapid traverse). The easiest way to determine this voltage is to connect the test adapter directly to the logic unit or to the connecting terminals of the servo-amplifiers and to measure with a multimeter.

If however, the axis does not move due to a defect, and you want to test whether the error is inside or outside the control, the following steps are recommended:

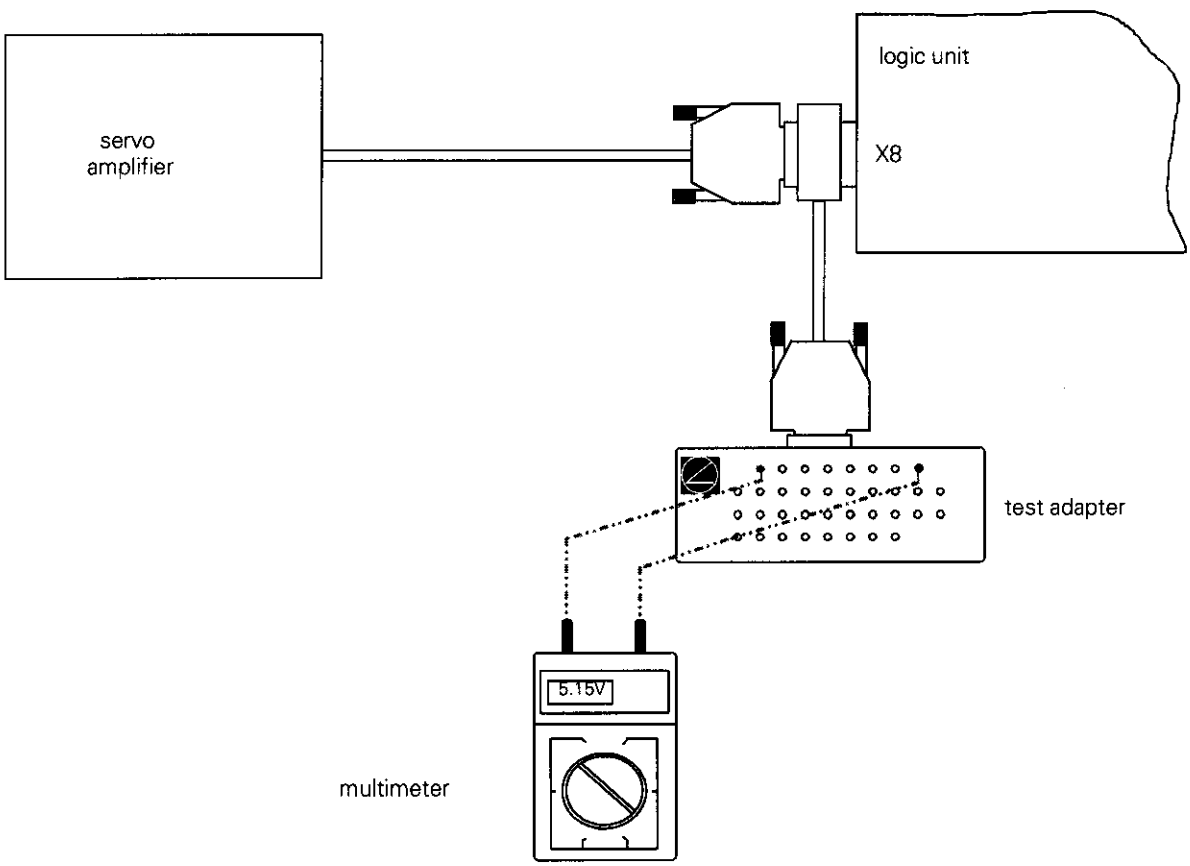
- Switch off the main switch at the machine tool.
- Connect the test adapter to the connector X8 (nominal value output) of the LE and connect a multimeter to the test adapter sockets for the defective axis. If no test adapter is available, connect a multimeter directly to the nominal value output of the servo-amplifier.
- Switch on the main switch and the control voltage.
- Switch the position display to LAG (servo lag) (see section 18.3).
- Check and adjust the following machine parameters:
  (If you alter a machine parameter, note down the original value and enter it again after finishing the test.)

MP	**Entry Value**	**Function**	**Original Entry Value**
1410	30 [mm]	Servo-lag monitoring (erasable), feed forward	
1420	30 [mm]	Servo-lag monitoring (EMERG. STOP), feed forward	
1140	9.99 [V]	Movement monitoring	
1710	300 [mm]	Servo lag monitoring (erasable), trailing mode	
1720	300 [mm]	Servo lag monitoring (EMERG. STOP), trailing mode	

- Traverse the reference points that need to be traversed before those of the defective axis.
- Turn the override potentiometer of the keyboard unit completely to the left and start reference mark traverse for the defective axis.
- Check the axis enable for the defective axis at the servo amplifier.
- Check the screen display.
  * (Control ready for operation) must be ON, the **F** of the feed rate display must be normally lit (if the display is inverse, the feed rate enable is missing), and the symbol for "Axis not in the position loop"
  (e.g. + X) should not follow the position display.
- Turn the override potentiometer slowly to the right and turn it back left again before the servo lag display reaches the limit of the position monitoring.

When the override potentiometer is turned to the right, the control outputs an analogue voltage which is increased proportionally to the servo lag up to a maximum value of 10V. The control operates correctly, if a voltage of 10V ± 0.1V can be measured at the test adapter with the multimeter. If no voltage can be measured, switch off the main switch, unplug the connector X8 from the logic unit, disconnect the nominal value line from the servo amplifier and test this line for short-circuit. If the nominal value line is in order, connect X8 to the logic unit again (leave the nominal value line disconnected), switch on the main switch and repeat the measurement with reference mark traverse. If an analogue voltage can be measured now, the control operates correctly. If no voltage can be measured, the analogue output of the logic unit is probably defective.

Measuring Setup to Check the Analogue Outputs



X8 Nominal value output for 1, 2, 3, 4, S

Flange socket with female insert (15-pin)

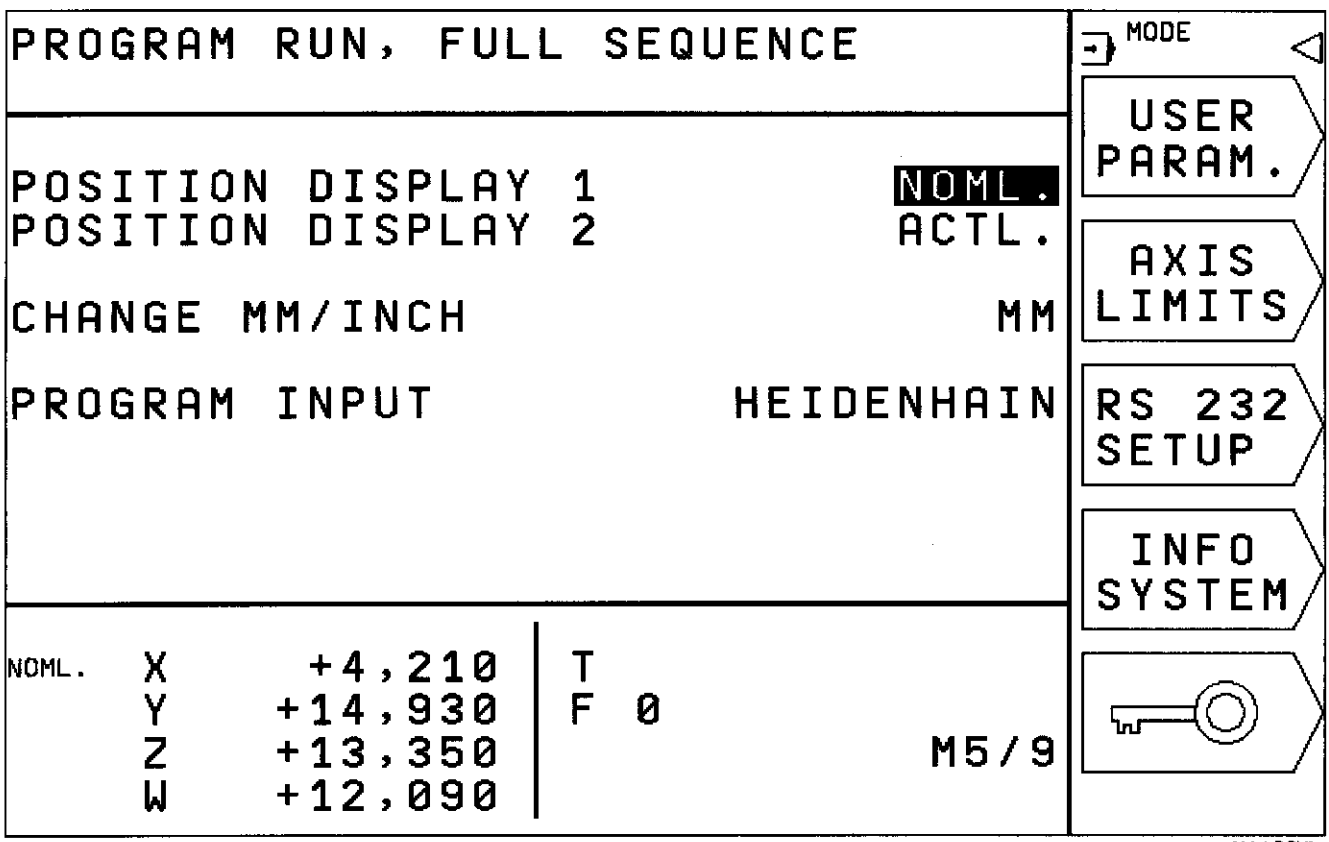
Pin No.	Signal designation
1	analogue output 1
3	analogue output 2
5	analogue output 3
7	analogue output 4
8	analogue output S-axis
9	0V analogue output 1

Pin No.	Signal designation
11	0V analogue output 2
13	0V analogue output 3
14	0V analogue output 4
15	0V analogue output S-axis
chassis	external shield = chassis
2, 4, 6, 10, 12	not connected

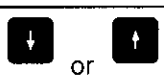
Observe the safety instructions!

18.3 Switching Over the Position Display

Press key	Function
	e.g. in operating mode "Full Sequence"
	Call MOD function



[11-I.PCX]

 or POSITION DISPLAY 1 xxxx POSITION DISPLAY 2 xxxx 	Select the item POSITION DISPLAY ⇒ main display ⇒ auxiliary display: POS. STATUS Switch to the desired position display: NOML: nominal position DIST: distance-to-go ACTL: actual position REF: distance to the ref. mark (machine datum), with distance-coded encoder: zero REF mark LAG: servo lag

18.4 Adjustment of the Feed Rate

Check and adapt the machine parameters (note down the original entry values).

MP	Entry Value	Function	Original Entry Value
1390	0	feed forward control [1] ON in automatic operating modes	
7290	0	display step = 1 µm	

- Switch position display to LAG (servo lag).

- Enter the following NC program (e.g. for X axis)

```
0  BEGIN PGM  X  MM
1  LBL 1
2  X + 0  F  MAX
3  X + 100  F  MAX      (select a larger traverse range if possible!)
4  CALL LBL  1  REP  100/100
5  END PGM  X  MM
```

- Run the test program in the operating mode "PROGRAM RUN / FULL SEQUENCE".

- Adjust the feed rate at the servo amplifier (tachometer) until the servo lag display is approximately zero for positioning in both directions.

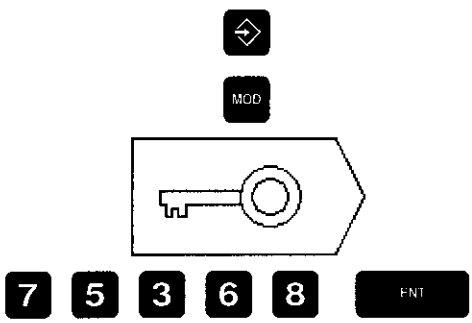
- Repeat the adjustment for all axes.

- Reset the machine parameters and the position display to the original values.

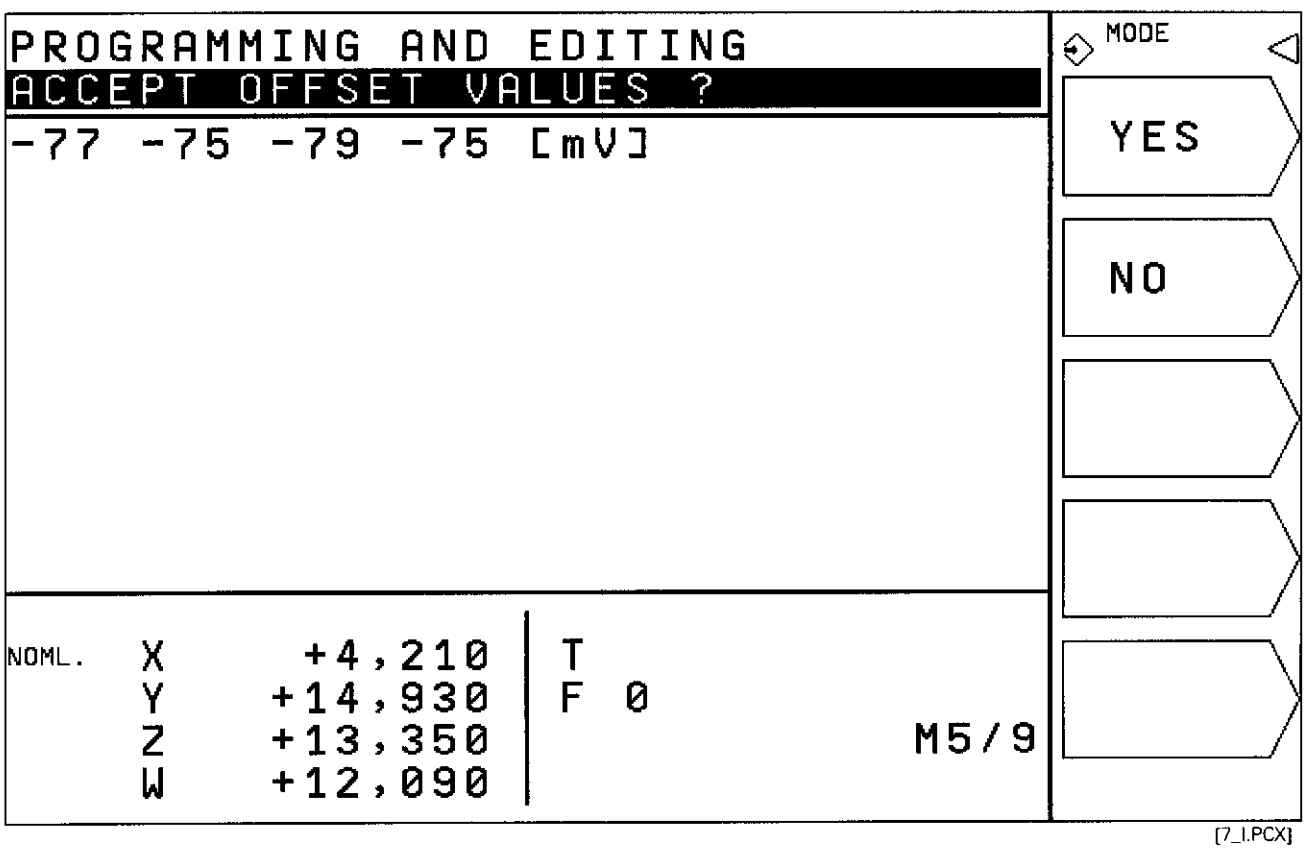
[1] The operating mode "feed forward control" must be optimized.

18.5 Offset Adjustment

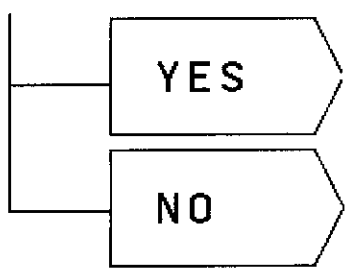
18.5.1 Offset Adjustment with Code Number

Press key	Function
	TNC in operating mode PROGRAMMING / EDITING Prepare TNC for input of code number Prepare TNC for input of code number Enter the code number for the offset adjustment and confirm with ENT

Now the contents of the offset memory is displayed on the screen in [mV]. From left to right: X, Y, Z, IV, V.



[7_I.PCX]

	Offset compensation is executed. Offset compensation is not executed or is cancelled

The offset adjustment with code number only compensates the **current** offset.
Subsequent offset modifications are **not** compensated.

18.5.2 Cyclic Offset Adjustment via Machine Parameters

In the machine parameter MP1220 the cycle time is defined [1s] after which an offset is compensated by one converter step.
To switch off the automatic offset adjustment, enter the value 0 in the machine parameter MP1220.

WARNING!

If an offset voltage of 100 mV is reached with automatic offset adjustment, the control switches off, generating the error message

GROSS POSITIONING ERROR <Axis> E

18.5.3 Offset Adjustment at the Servo Amplifier

- Check and adjust the following machine parameters. (Note down the original values before changing.)

MP	Entry Value	Function	Original Entry Value
1080.0 1080.1 1080.2 1080.3	0 0 0 0	Integral factor X Integral factor Y Integral factor Z Integral factor IV	
1220	0	cycle time for automatic offset adjustment	
1390	0	feed forward control ON	
1510.0 1510.1 1510.2 1510.3	≥ 1 ≥ 1 ≥ 1 ≥ 1	KV factor for feed forward control	
7290	0	display step = 0.1 µm	

- Switch position display to LAG (display of servo lag); see section 18.3.
- Cancel the offset compensation with code number; see section 18.5.1.
- Adjust the offset at the servo amplifier until the values of the individual axes are zero or oscillate symmetrically about zero.
- Reset the machine parameter values and the position display to their original values.

19. PLC Inputs and Outputs

19.1 PLC Inputs

19.1.1 PLC Inputs on LE

Connector X42: I0 to I31 and acknowledgement "Control ready for operation"
Connector X46: I128 to I151

"0"-signal U_e =- 20V to 3.2V
I_e = 0.06mA with U_e = 3.2V

"1"-signal U_e =13V to 30.2V
I_e =2.50mA to 5.90mA

19.1.2 PLC Inputs on 405B/410B

PL 405B, terminal strips X3 to X4: I64 to I95
PL 410B, terminal strips X3 to X6: I64 to I127

"0"-signal U_e =- 20V to 4V
I_e = 1.6mA with U_e = 4V

"1"-signal U_e =16.5V to 30V
I_e =6.2mA to 12.6mA

19.2 PLC Outputs

19.2.1 PLC Outputs on LE

Connector X41: O0 to O30 and output "Control ready for operation"
Connector X46: O0 to O7 [1]

[1] available at X46 or X41

"1"-signal $U_{a\ min}$ = U_B - 1.6V
$I_{a\ max}$ = 100mA

19.2.2 PLC Outputs on PL 405B/410B

PL 405B, terminal strip X8: O48 to O62 and output " Control ready for operation"
PL 410B, terminal strips X7 to X8: O32 to O62 and output " Control ready for operation"

"1"-signal $U_{a\ min}$ = U_B - 3V
$I_{a\ NOM}$ = 1.20A

Pin layout: section 6

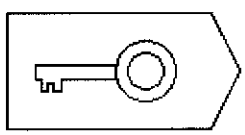
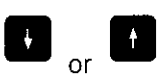
19.3 Checking the PLC Inputs and Outputs

The test unit (see section 20) can be used to check the PLC inputs and outputs on the logic unit (X41, X42, X46). The voltage level of the PLC inputs and the output current of the PLC outputs on the PL 400/405/410 can be measured directly at the terminals.

19.3.1 PLC Inputs

The PLC inputs can be checked as follows:

- Connect the test unit between LE and PLC (measure directly at the PL boards).

Press key	Function
	TNC in operating mode PROGRAMMING / EDITING
	Call MOD function
	Prepare TNC for input of code number
	Enter code number; confirm with ENT
	Press the arrow keys to move the cursor to TABLE I/O/C/T/M/B/W/D
	Call table function
	Call "input" table

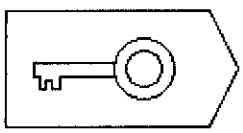
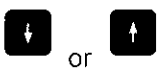
Now the logic states of the **inputs** are displayed on the screen. They must correspond to the voltage levels of the corresponding inputs (voltage levels: see section 19.1). If there is a difference and the input voltage is correct, the input board of the PLC graphics board or the PLC I/O board PL 400/405/410 is probably defective.

	Return to menu

Observe the safety instructions!

19.3.2 PLC Outputs

The PLC outputs can be checked as follows:
- Connect the test unit between the PLC and the LE (measure directly at the PL boards).

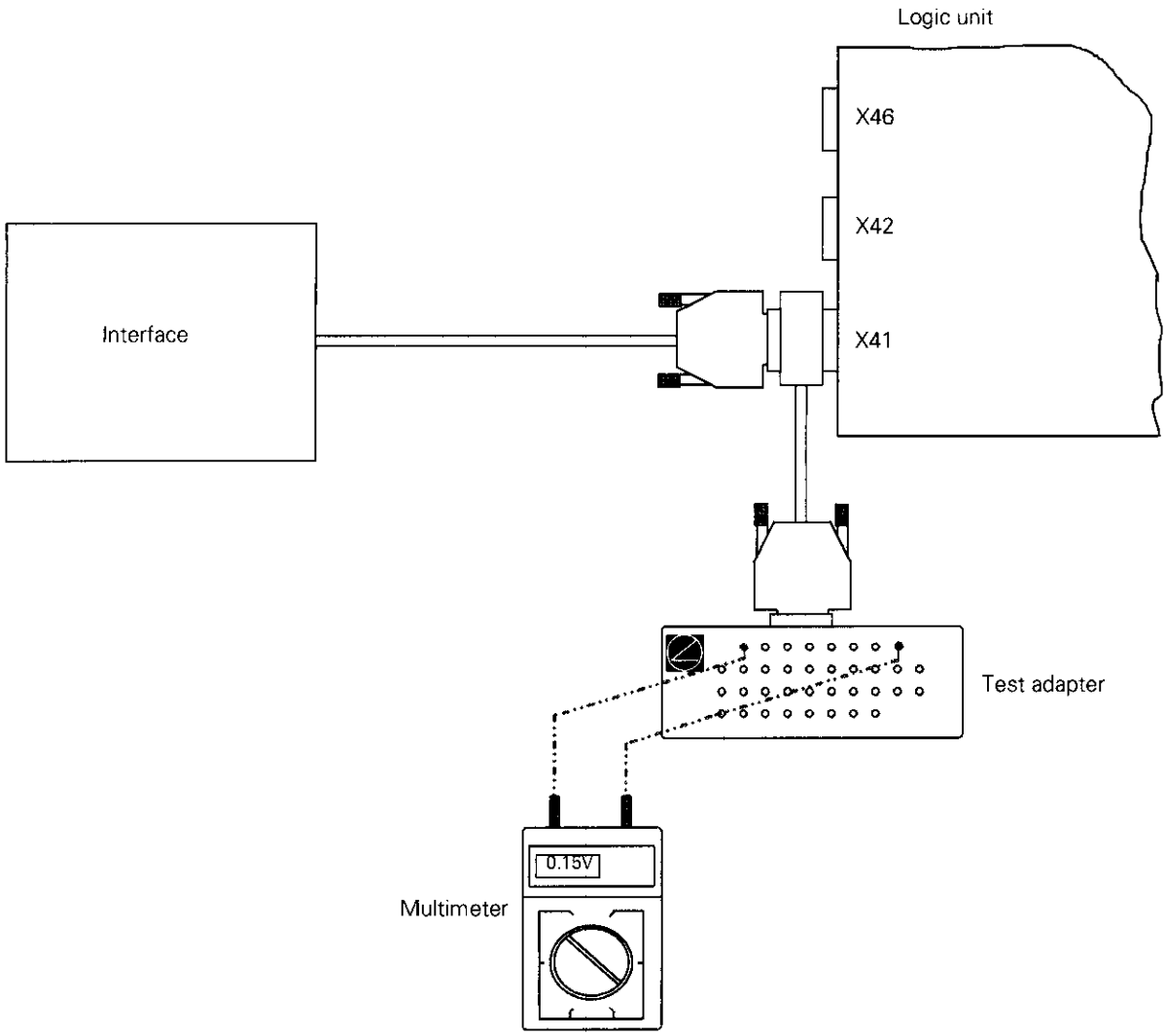
Press key	Function
	TNC in operating mode PROGRAMMING / EDITING
MOD	Call MOD function
	Prepare TNC for input of code number
8 0 7 6 6 7 ENT	Enter code number; confirm with ENT
 or	Press the arrow keys to move the cursor to TABLE I/O/C/T/M/B/W/D
ENT	Call table function
	Call "output" table

Now the logic states of the **outputs** are displayed on the screen. They must correspond to the voltage levels of the corresponding outputs. If there is a difference, check the output cable for short circuit and measure the output current at the interface (max. 100 mA for LE outputs, max. 1.2 A for PL outputs). If the output current is not exceeded and the connecting cable is in order, the output board of the PLC graphics board or the PLC I/O board PL 400/405/410 is defective.

END END	Return to menu

Observe the safety instructions!

19.3.3 Measurement Setup for PLC Inputs and Outputs on the LE

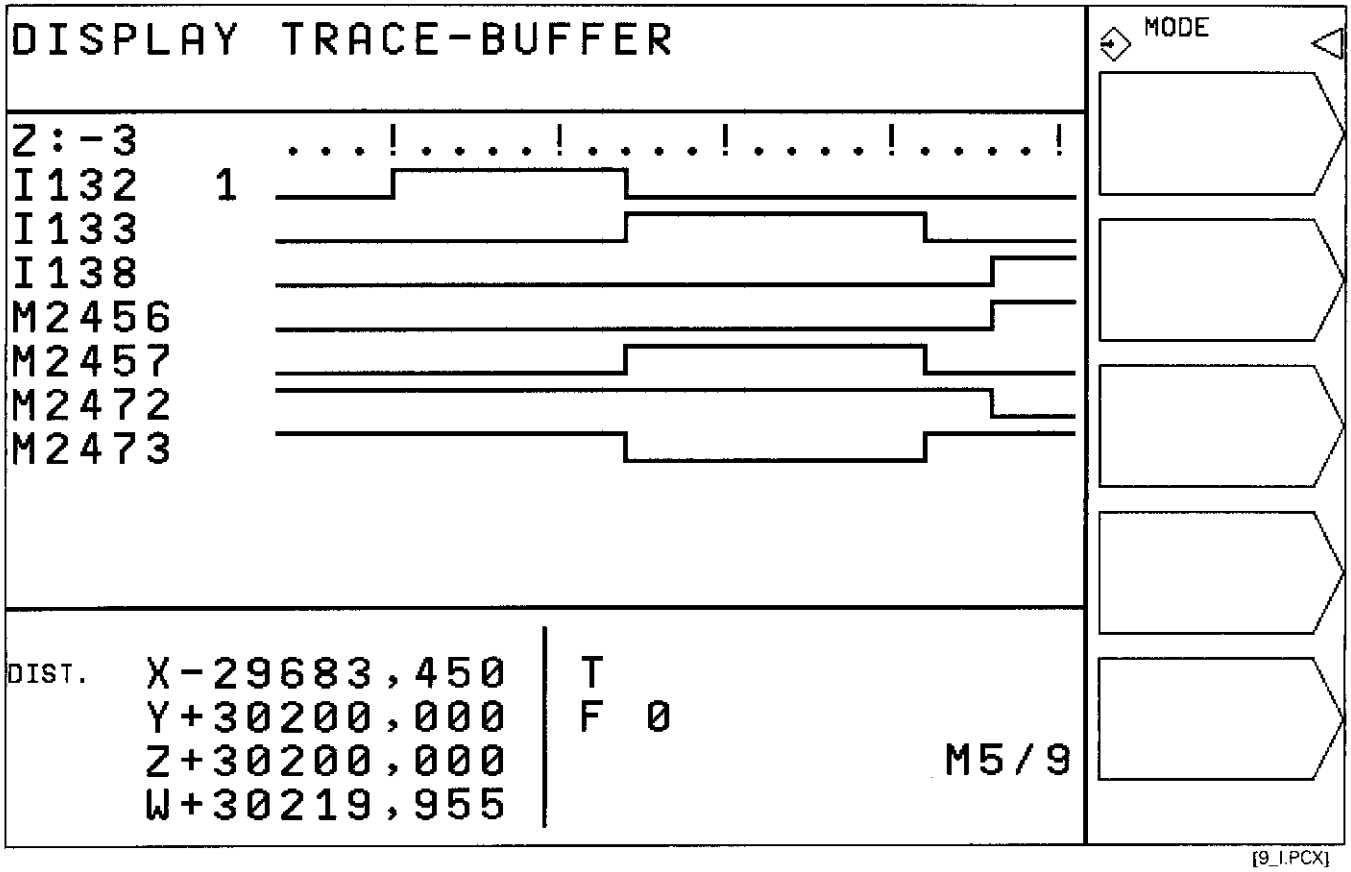


X41 : PLC output
X42 : PLC input
X46 : machine operating panel

Observe the safety instructions!

19.4 Diagnosis Possibilities in the PLC Mode

19.4.1 TRACE Function



The logic states of up to 16 operands (M, I, O, T, C) can be displayed on the screen.
1024 PLC scans can be traced.

Selecting the Operands and Starting the Logic Diagram

Press key	Function
PLC-PROGRAM TRACE-FUNCTION	
ENT	Call TRACE function
SELECT I/O/C/T/M	
ENT	Call menu

A table is displayed from which the operands can be selected. The control requests the positions of the table in a dialogue. Wrong inputs can be cleared by pressing DEL. It is possible to enter a trigger condition for each operand. 512 states are traced before and after a trigger event. The following trigger conditions are possible:

"1" ⇒ trace if the operand is a logical "1"
(trigger on positive edge)

"0" ⇒ trace if the operand is a logical "0"
(trigger on negative edge)

NO ENT ⇒ no trigger
If no trigger condition is entered for any of the operands, the operand states are traced continuously and the last 1024 states are stored.

e.g.: 0 I5 1 ⇒ trigger on positive edge
1 O6 0 ⇒ trigger on negative edge
2 M2003 ⇒ no trigger

END	Return to main menu after selection
START TRACE	
ENT	Start TRACE function

The trace function is started with START TRACE; END TRACE or a trigger event terminate the tracing.

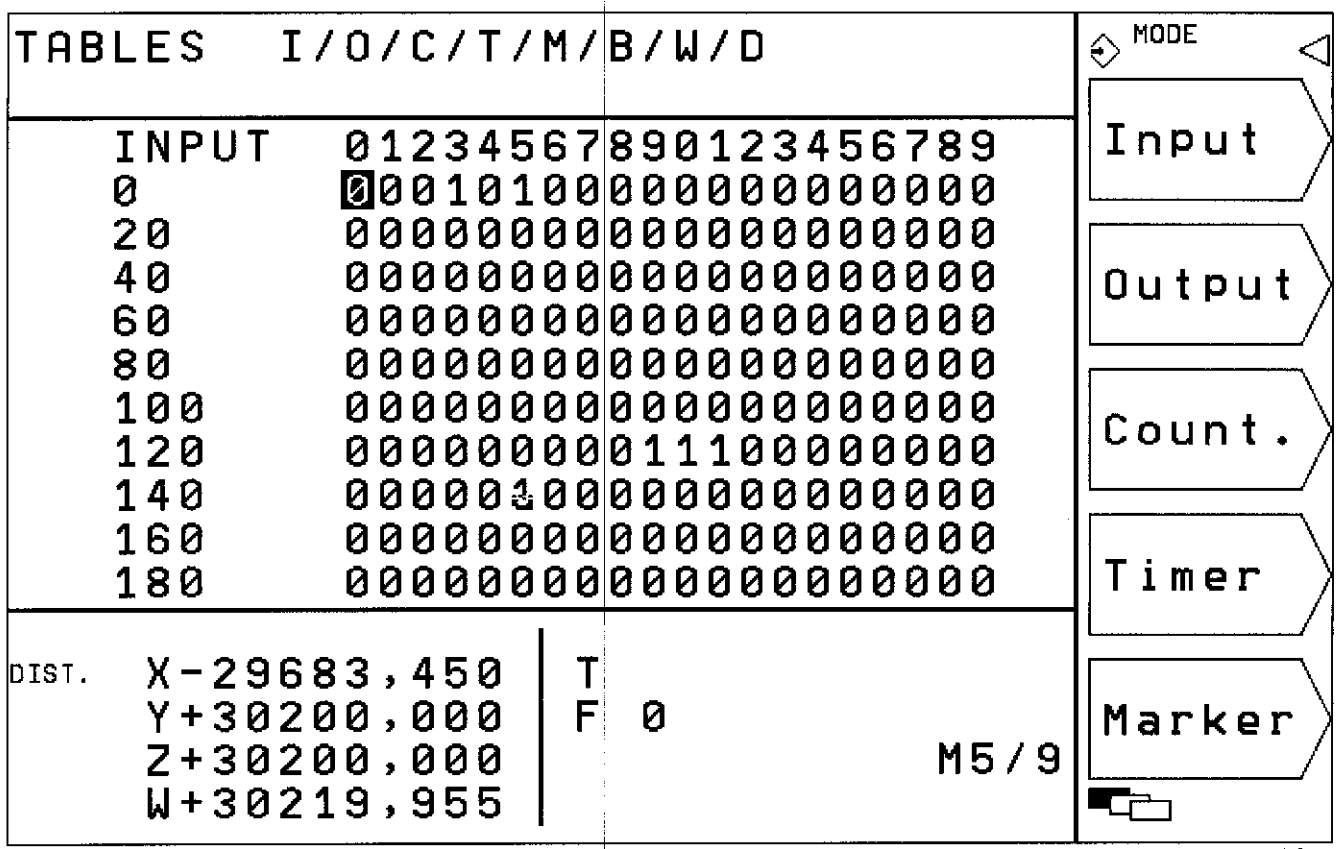
In the status line "PCTR" is displayed:

PCTR blinking : trigger condition has not occurred yet
PCTR on : trigger condition has occurred; write access to buffer memory
PCTR off : buffer memory is full; LOGIC DIAGRAM can be called

DISPLAY TRACE BUFFER	Switch to TRACE mode
ENT	Call logic diagram
END END	Return to main menu

19.4.2 TABLE Function

Press key	Function
TABLE I/O/C/T/M/B/W/D ENT	Call TABLE function



[10_I.PCX]

▽ ▽	Activate extended menu

After pressing a soft key, the corresponding table is activated.
The logic states of the markers, inputs, outputs, counters and timers are dynamically displayed. In the tables for bytes, words and double words, the display can be switched between HEX and DECIMAL.

With the cursor keys or the GOTO key, positions of a table can be selected.

19.5 Output "Control Ready for Operation" and Acknowledgement for Test " Control Ready for Operation "

Important functions are monitored in the TNC 370 by way of a self-diagnosis system (electronic assemblies such as micro-processor, EPROM, RAM, positioning systems, encoders etc.).

If an error is detected, a blinking error message in plain language is displayed in the dialogue line. As soon as this error message is generated, the control opens the output "Control Ready for Operation".

The output "Control Ready for Operation" is available via:

Logic unit,	connector X41	pin 34
PL 405B,	terminal strip X8	pin 16
PL 410B,	terminal strip X8	pin 16

By switching off the power switch or by pressing

, this state can be cancelled, provided that the error cause has been eliminated.

The output "Control Ready for Operation" is to switch off the +24V control voltage in the machine tool interface. Since this is an important safety function, the switch-off function of the output "Control Ready for Operation" is tested via the input "Acknowledgement Control Ready for Operation" each time the control is switched on.

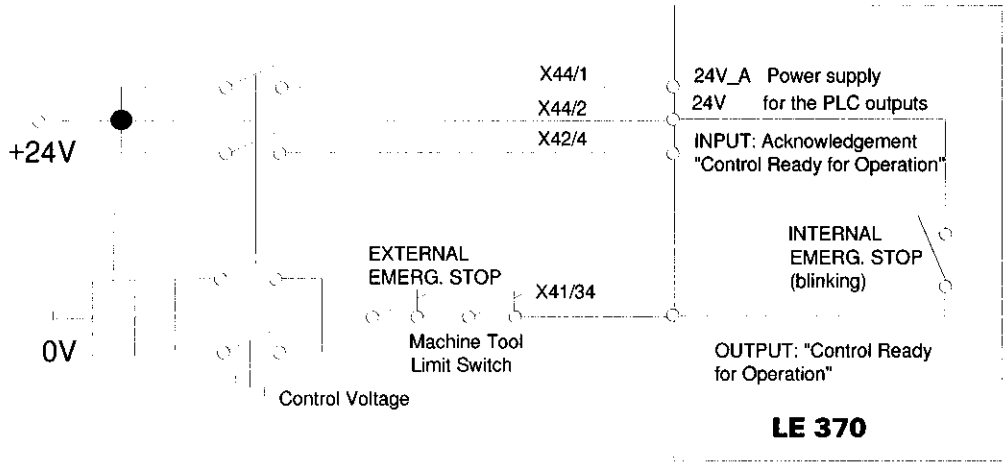
If the +24V at the input "Acknowledgement Control Ready for Operation" are missing during the test routine after power-on, the error message " RELAY EXT. DC VOLTAGE MISSING" is displayed. If however, the acknowledgement is switched off too late (or not at all) after the output has been switched off, the blinking error message "EMERGENCY STOP DEFECTIVE" is generated.

If the control detects an error during the power-on test routine, a bridge can be inserted between the output "Control Ready for Operation" and the input "Acknowledgement Control Ready for Operation" (disconnect the wires) in order to determine whether the defect is due to the control or to the interface. If the error is still present after inserting the bridge and with correct PLC power supply, the defect is located in the logic unit. If however, the error does not occur with the bridge being inserted, the defect is located in the interface.

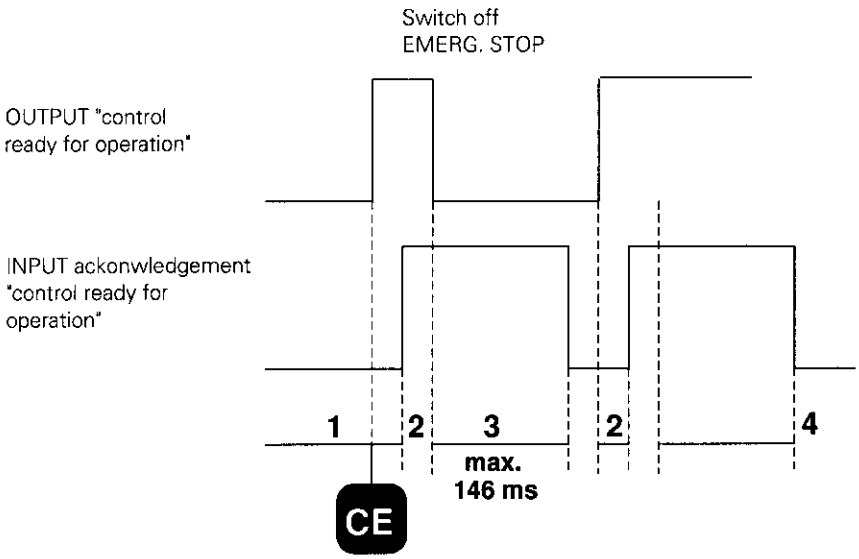
Warning!
Do not forget to remove the bridge and to install the standard operating state after the test.

Observe the safety instructions!

19.5.1 Wiring of the EMERGENCY STOP Interface (Basic Circuit Diagram)



19.5.2 TNC 370 Flow Diagram



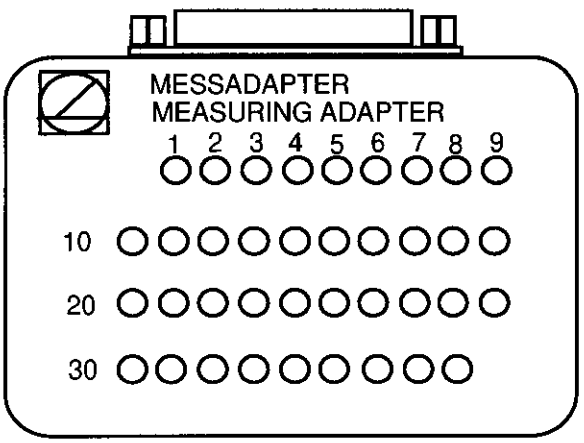
Time	Remarks	Error Message
1		**POWER INTERRUPTED**
2	Waiting for control voltage	**RELAY EXT. DC VOLTAGE MISSING**
3	After switching off the output "Control Ready for Operation", the "Acknowledgement Control Ready for Operation" must be switched off within 114 ms; otherwise the blinking error message is generated.	**EMERGENCY STOP DEFECTIVE**
4	If the acknowledgement is switched off during operation, the error message is displayed.	**EMERGENCY STOP**

20. Test Units

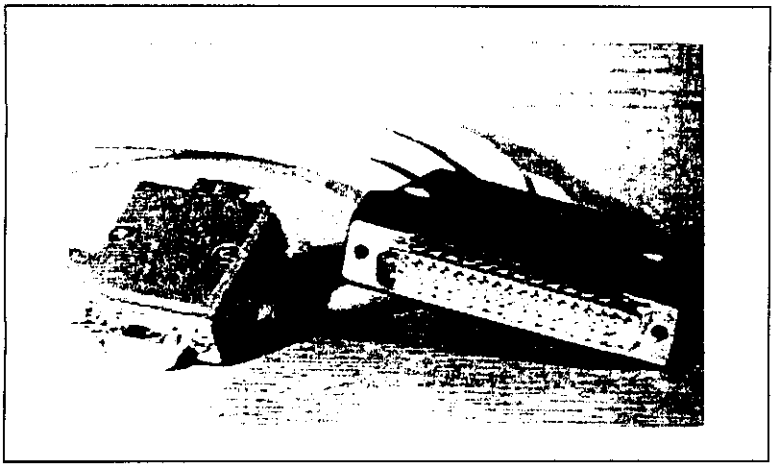
20.1 Universal Measuring Adapter (Test Adapter)

Used:

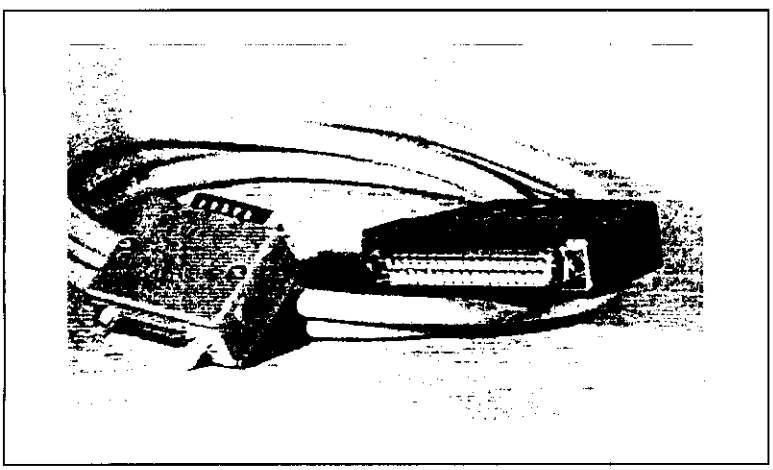
- as universal testing device for D-Sub connectors, 9-pin to 37-pin (Id.No. 255 480 01)



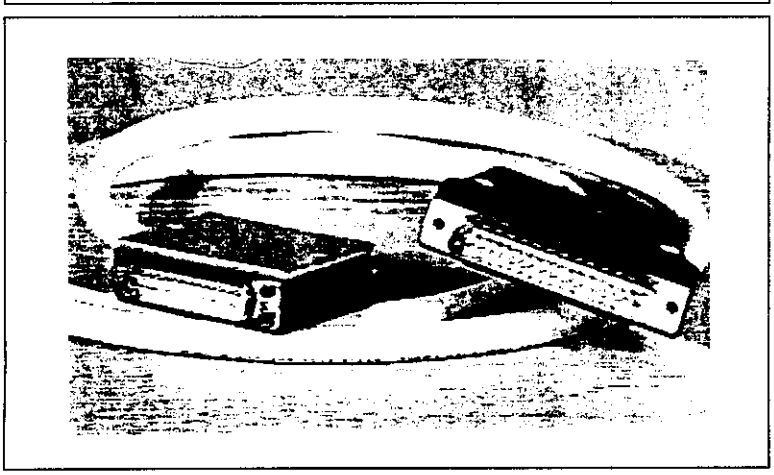
The measuring adapter can be used to test the inputs and outputs of D-Sub connectors (9-pin to 37-pin). On the following page the adapter cables are shown that are required for the different connectors.



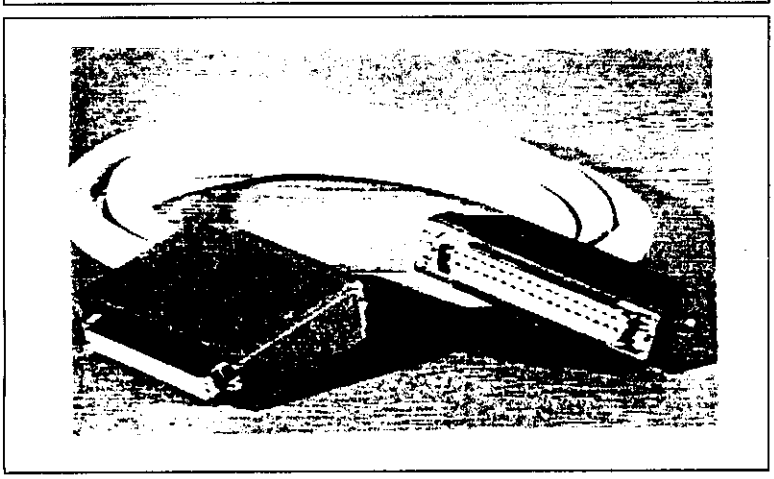
Adapter cable, 9-pin
Id.No. 255 481 01



Adapter cable, 15-pin
Id.No. 255 482 01



Adapter cable, 25-pin
Id.No. 255 483 01

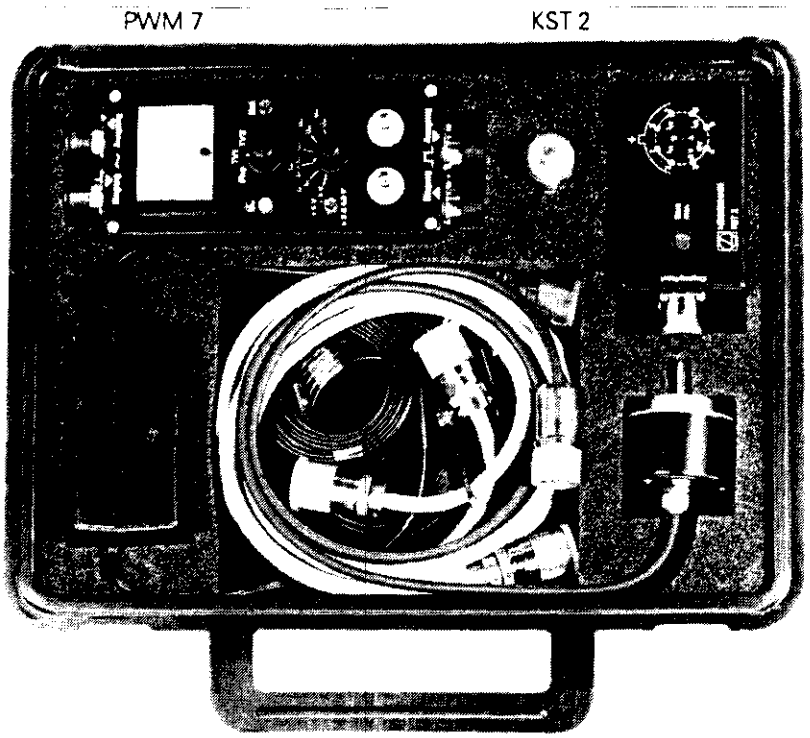


Adapter cable, 37pin
Id.No. 255 484 01

20.2 Encoder Diagnostic Set, Id.No. 254 599 01

Used:

- to test the electrical functions of an encoder.
  (Further information please see from the operating instructions of the Diagnostic Set.)



21. Exchange Instructions

21.1 Important Information

Observe the safety instructions!

21.1.1 Required Equipment

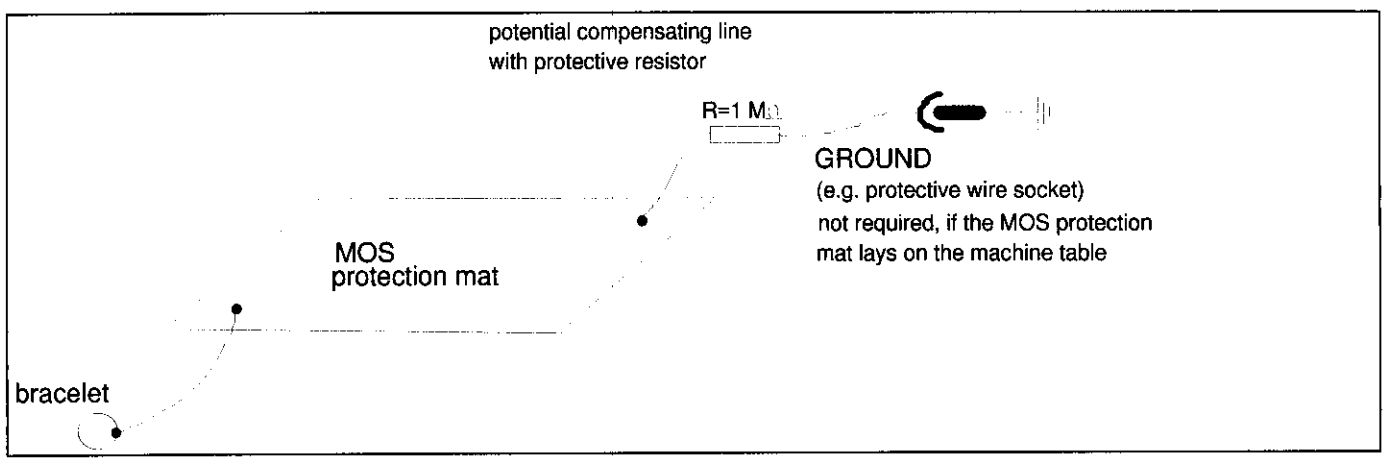
1 external data medium, e.g. FE 401/B or PC with transfer software (e.g. TNC.EXE)
1 tool set (screw driver, socket wrench etc.)
1 MOS protection device (only required for exchanging boards or EPROMs)
1 IC insertion and extraction tool (only required for exchanging EPROMs)

21.1.2 MOS Protection

If the processor board, the PLC graphics board, the CLP boards or EPROMs are to be exchanged, a MOS protection is definitely required, since otherwise MOS components on the boards or the EPROMs may be destroyed.

Caution!
Avoid any unprotected handling of the boards or EPROMs with statically charged objects (packaging material, storage etc.).

MOS Protection



21.1.3 Software Compatibility

Exchange units (LOGIC UNIT) are always supplied with the most recent software version. Exchange boards, however, are delivered **without** software and without software enable module. Therefore, the EPROMs and the software enable module of the defective board must be inserted into the exchange board at site.
Always remove the EPROMs and the software enable module before sending us boards for repair!)

21.2 Exchanging the NC Software of TNC 370

Proceeding:

The NC software of TNC 370 should be exchanged as explained below. Depending on the software version, the machine model and its features maybe not all steps need to be carried out.

21.2.1 Backing up RAM Data

Before the NC software is exchanged, important information stored in the RAM must be written down or read out:

- **Data files** (part programs, MP list etc.)
- **MODE settings** (position display etc.)
- **AXIS-LIMIT** (limitations of traverse range)
- **Calibration data** for touch probe (if available)
- **RS 232 SETUP** (baud rate, operating mode)
- **Datums**

DATA FILES (part programs, MP list etc.)

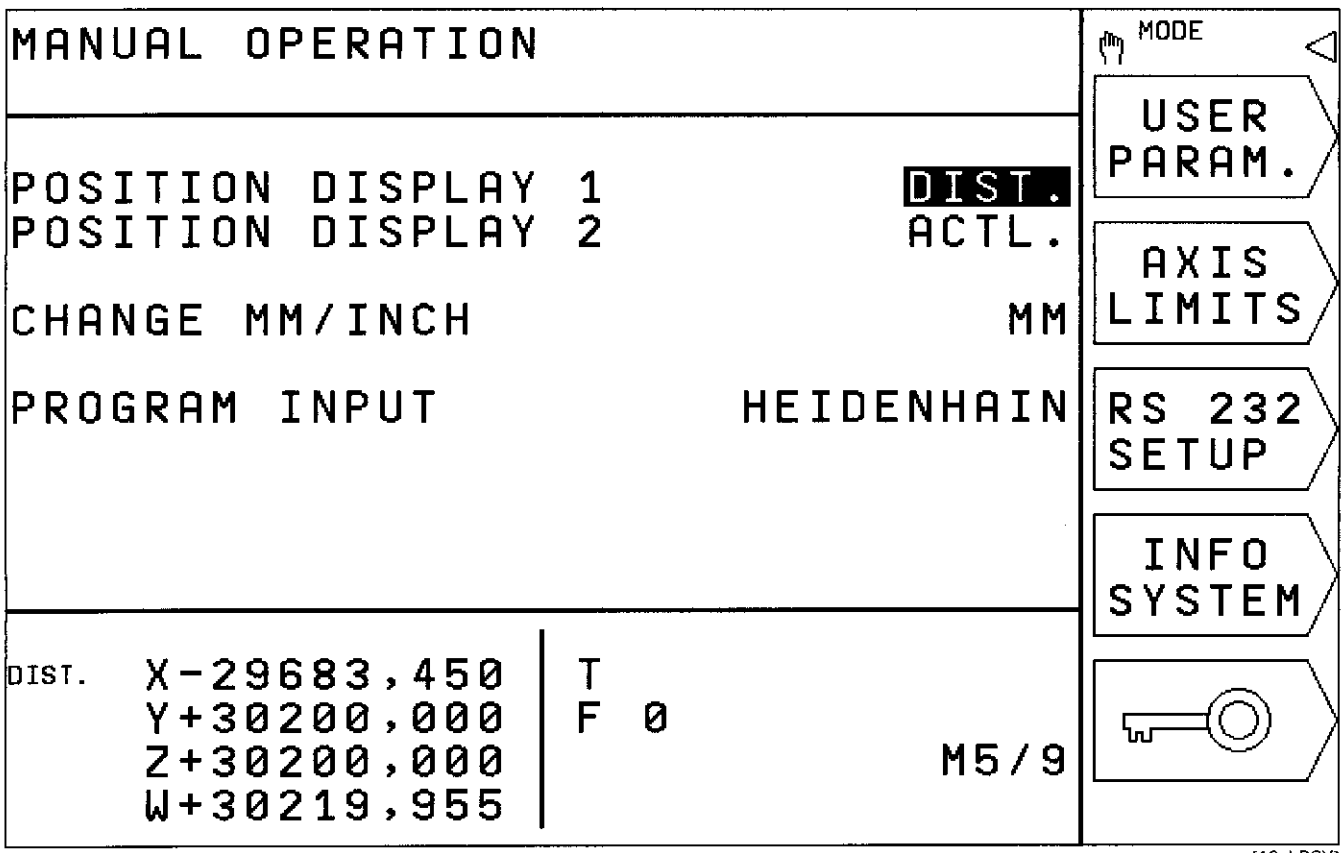
File type	Extension in TNC	Extension on Ext. Medium
NC program, HEIDENHAIN dialogue	.H	.H
NC program, ISO	.I	.D
Tool table	TOOL.T	TOOL.T
Pocket table	TOOLP.TCH	TOOLP.R
PLC program		.P
Machine parameter list		.M
Multipoint error compensation		.S

All data stored in the control must be read out **before** the NC software is exchanged (see section 17.2). **After** the exchange, these data need to be read in again (see section 17.3).

As a rule, all data files should be backed up on an external data medium!
For this purpose HEIDENHAIN offers a data transfer software (TNC.EXE).

MODE Settings

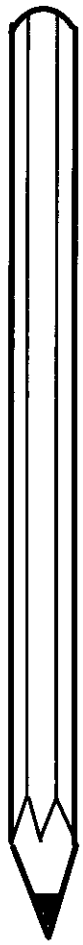
Press key	Function
	TNC in MANUAL operating mode
	Call MOD function



[12_I.PCX]

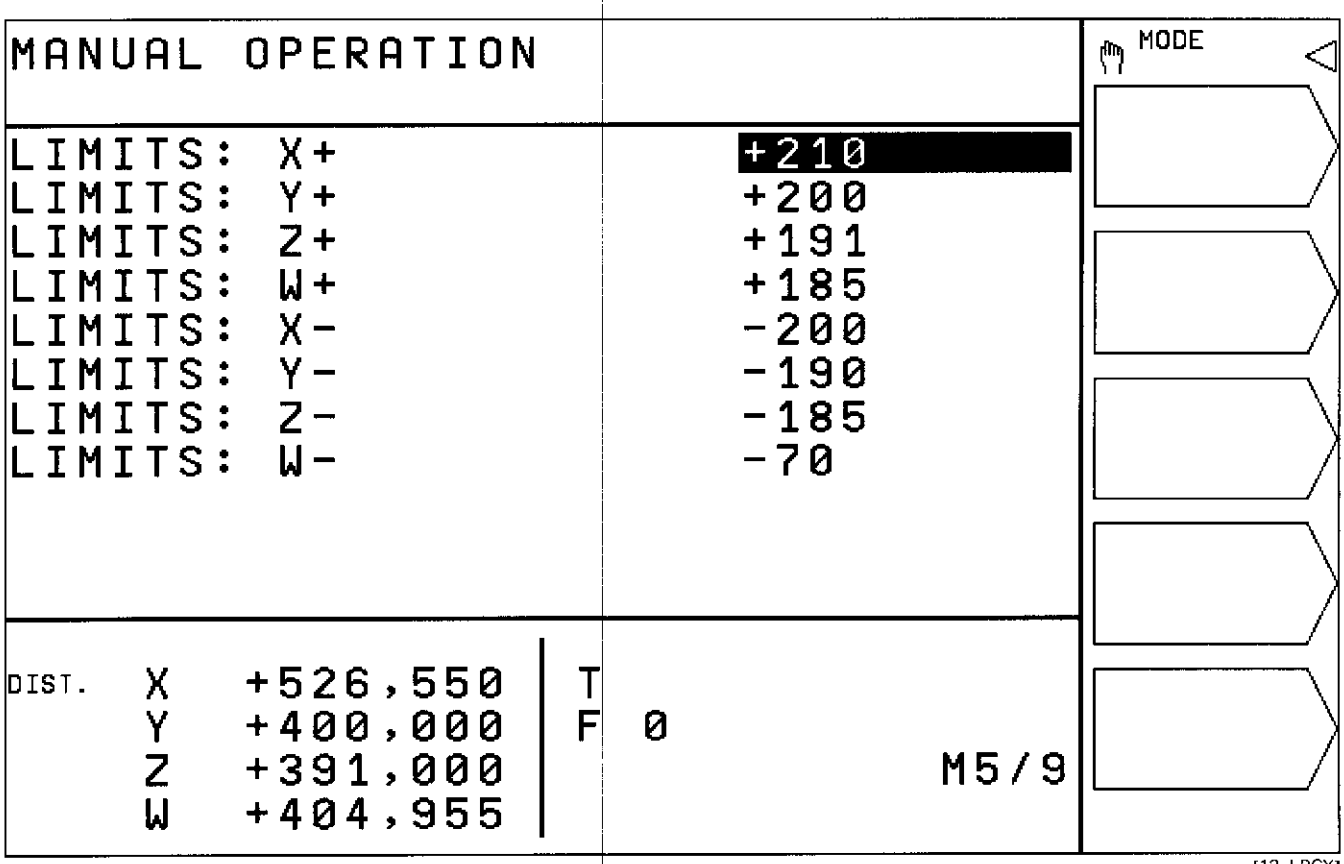
The settings displayed on the screen must be noted down so that they can be reset after the NC software was exchanged.

NOTES



AXIS LIMIT

Press key	Function
	TNC in MANUAL operating mode
MOD	Call MOD function
AXIS LIMITS	Call table of axis limits



[13_I.PCX]

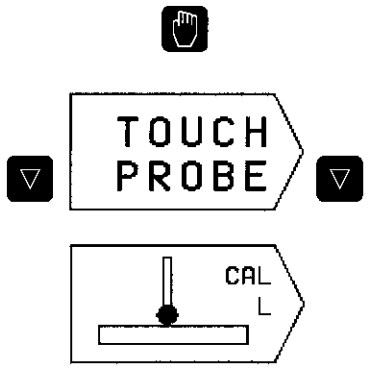
Die The settings displayed on the screen must be noted down so that they can be reset after the NC software was exchanged.

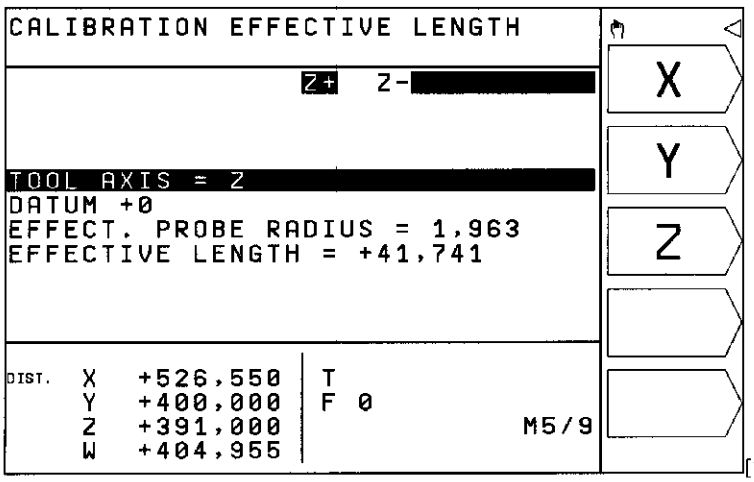
NOTES

AXIS LIMIT

CALIBRATION DATA for the Touch Probe

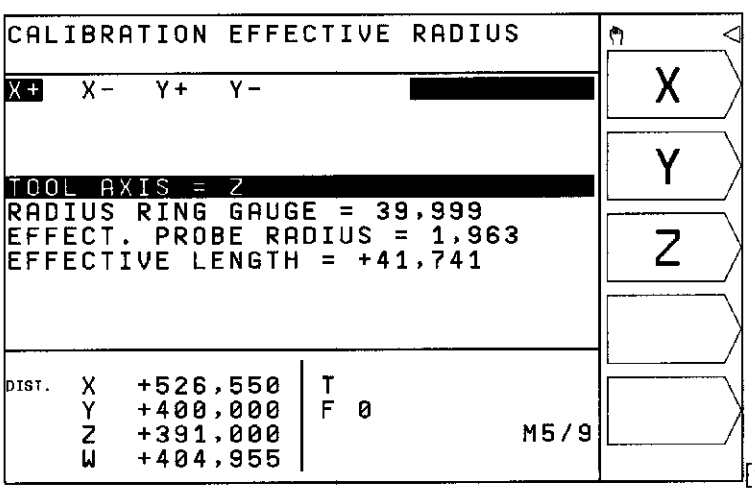
The calibration data of TS 120 (TS 511) must be written down and re-entered after the software exchange.
If the TT 110 touch probe is used, it must be **recalibrated** after the software exchange.

Press key	Function
	TNC in MANUAL operating mode Call probing functions TS 120 (TS 511) Call and note down TS 120 (TS 511) calibration data: LENGTH



[16_I.PCX]

	Call and note down TS 120 (TS 511) calibration data: RADIUS



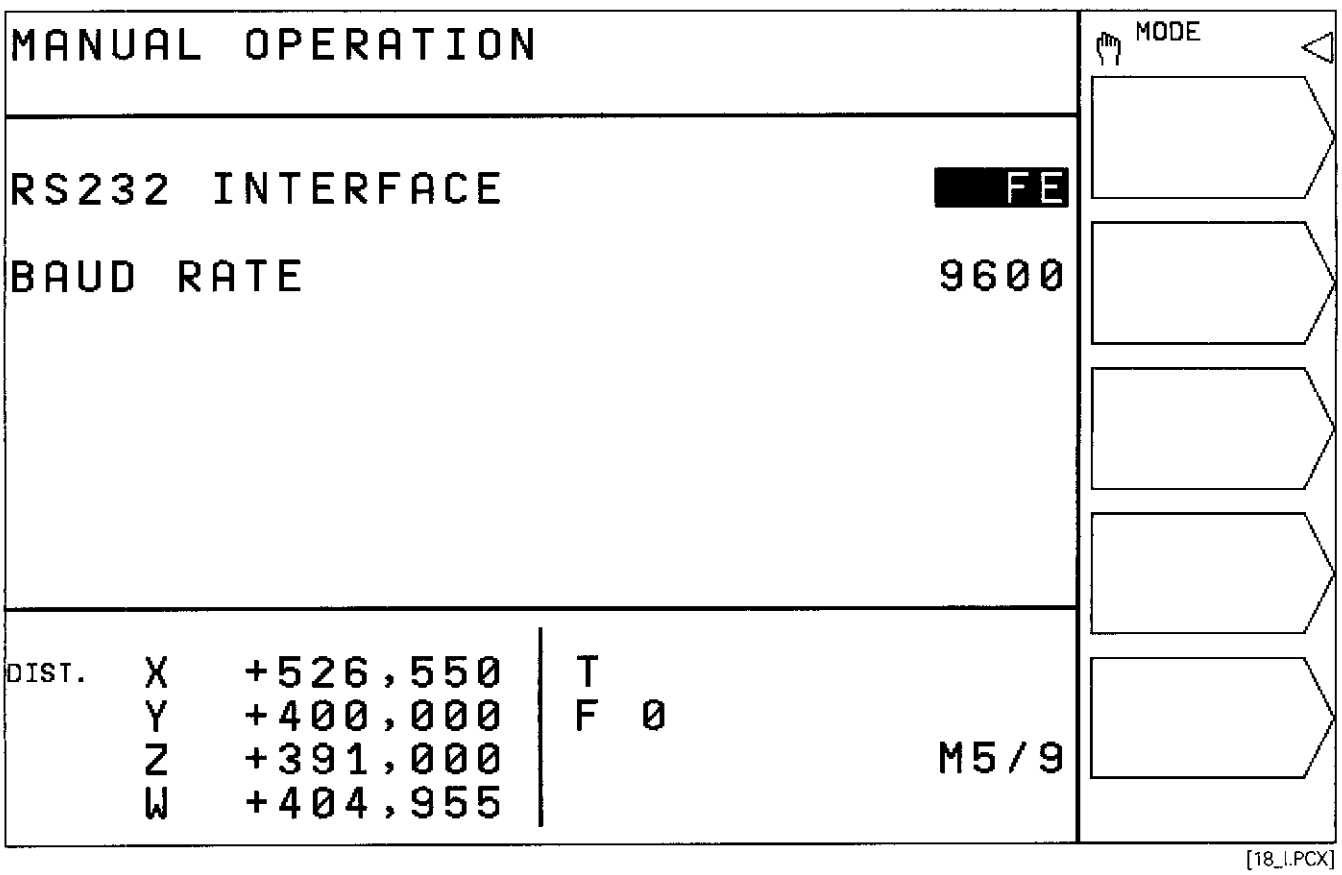
[17_I.PCX]

NOTES

CALIBRATION DATA for Touch Probe

Settings of the RS 232 Data Interface

Press key	Function
	TNC in MANUAL operating mode
	Call MOD function
	Call interface menu



[18_1.PCX]

The settings displayed on the screen must be noted down so that they can be reset after the NC software was exchanged.

NOTES

Settings of the RS 232 Data Interface

DATUMS

Press key	Function
Finding the datums	
Switch power off	Switch off main switch and wait for approx. 5 seconds
Switch power on	
POWER INTERRUPTED	
CE	Clear message
TRAVERSE REFERENCE POINTS	Do **NOT** traverse the reference points
Switch the position display to **ACTL** and write down the current position values!	
Resetting the datums (e.g. after the NC software was exchanged or in an exchange control)	
Switch power off	Switch off main switch and wait for approx. 5 seconds
Switch power on	
POWER INTERRUPTED	
CE	Clear message
TRAVERSE REFERENCE POINTS	Do **NOT** traverse the reference points
PRESET	Call "pre-set" option
e.g.: X	Call "pre-set" option for e.g. X-axis
DATUM SETTING X =	Enter the value determined before the software exchange (e.g. for the X-axis) and confirm with ENT !
Y etc.	Same procedure for the remaining axes
END	Return to REF mode and **traverse the reference points**!

NOTES

DATUMS

21.2.2 Defined State of Machine Tool and Axes

Machine tools with tool changer:

- Insert T0 (empty spindle).
- Move tool changer to a defined position.
  (Contact your machine tool manufacturer!)

Machine axes in general:

- Move the axes to the middle of the traverse range
  (away from the hardware limit switches).

21.2.3 Exchanging EPROMs

- Switch off the machine and exchange the EPROMs using an IC insertion/extraction tool.

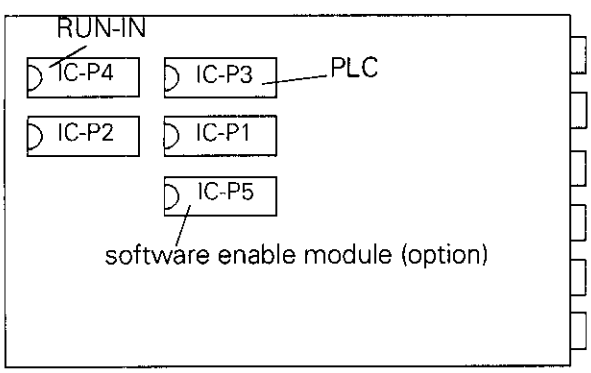
When exchanging the EPROMs, a MOS protection is definitely required, since otherwise MOS components on the boards or the EPROMs may be destroyed.

Caution!
Avoid any unprotected handling of the boards or EPROMs with statically charged objects (packaging material, storage etc.).

EPROM Location Diagram TNC 370

PGM No. 280 600 - 609 ..

Processor Board



IC-P1 NC software 1. EPROM
IC-P2 NC software 2. EPROM
IC-P3 PLC EPROM
IC-P4 RUN-IN (internal HEIDENHAIN test program)
IC-P5 software enable module (option)

21.2.4 Preparing the Control for Operation

- Switch on main switch.

- Download the machine parameter list and activate the list by pressing END (see section 17.3.3).
- Delete all remanent markers and words by entering the code number 531210.
- Download all remaining data files (part programs etc.) (see section 17.3).

21.2.5 Establishing the Previous State of the Machine Tool

- Re-enter the settings of section 21.2.1.
- Execute offset adjustment by entering the code number 75368.
- For machines with tool changer:
  Re-initialize the tool changer (information will be provided by the machine tool manufacturer!).

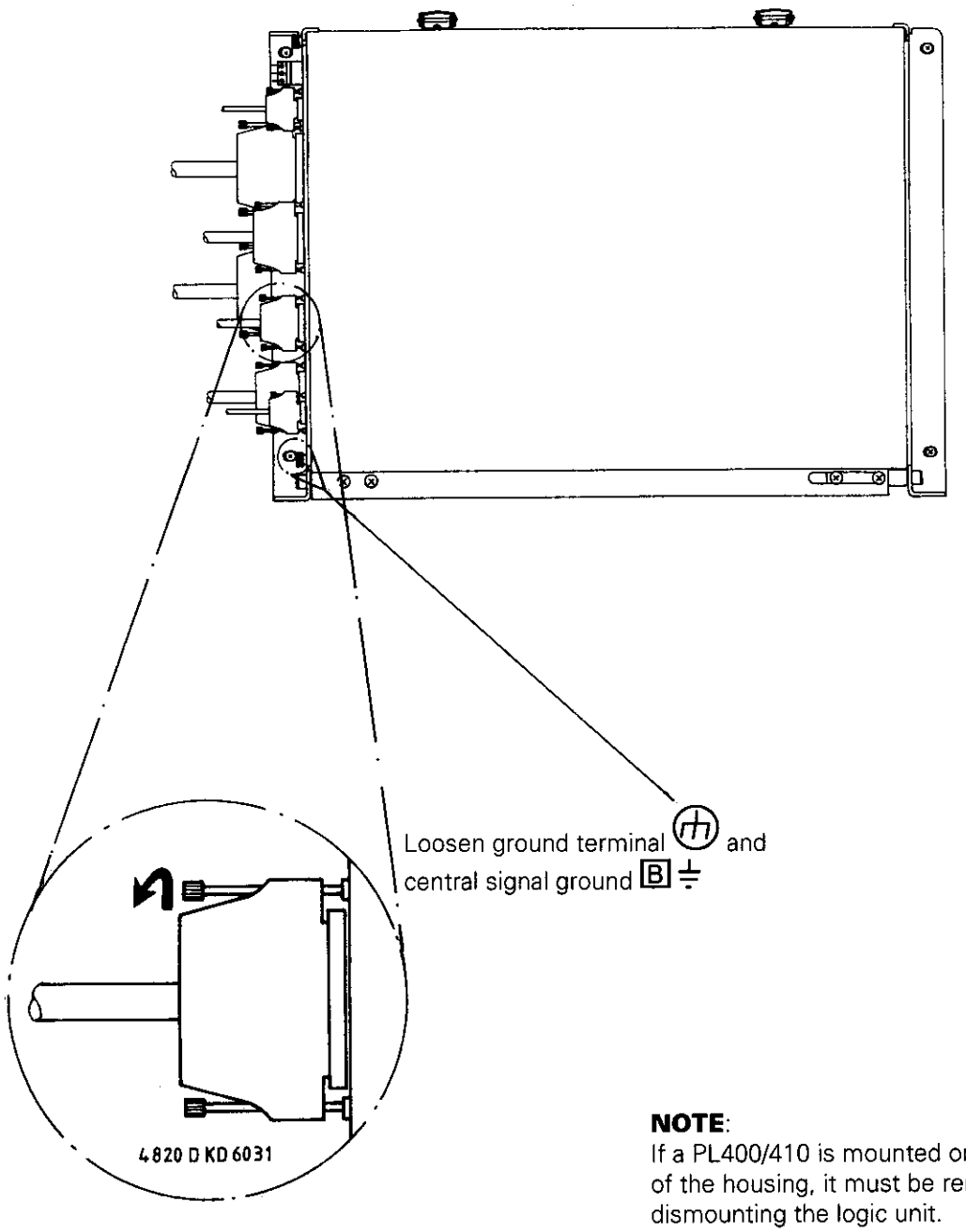
NOTES

21.3 Exchanging the LOGIC UNIT

21.3.1 Observe the exchange instructions (section 21.1) and back up the data as described in section 21.2.1.!

21.3.2 Dismounting the Logic Unit

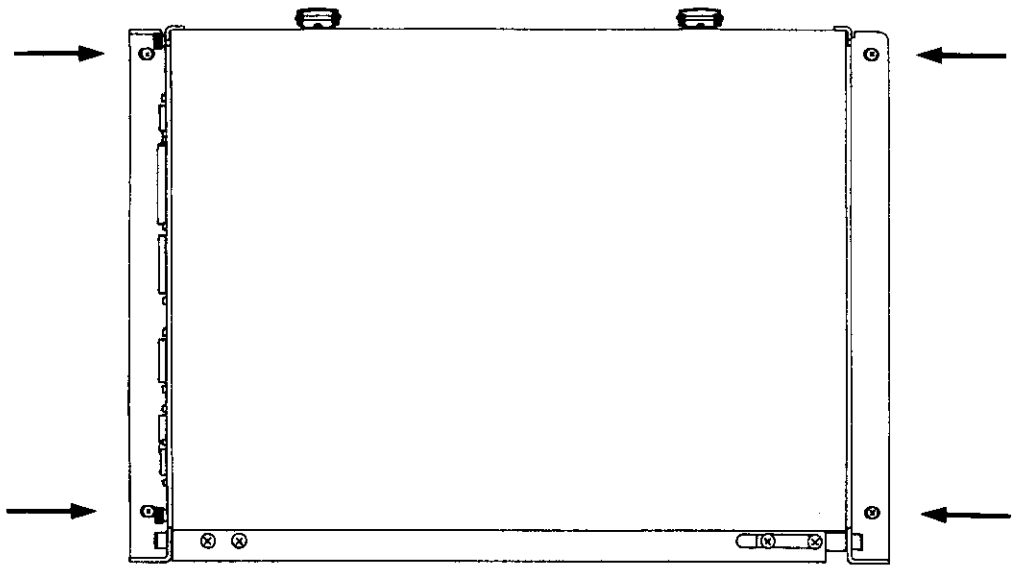
a) Switch power off.
b) Loosen all plug connections and clamped joints at the logic unit.



D-Sub connector
Loosen knurled screw

NOTE:
If a PL400/410 is mounted on the upper side of the housing, it must be removed before dismounting the logic unit.

c) Loosen the 4 mounting screws on the logic unit



d) Remove the old logic unit and insert the new logic unit.

21.3.3 Mounting the LOGIC UNIT

The logic unit is mounted in the reverse order that is was dismounted.

a) Insert and secure the logic unit.
b) Engage the connectors.

Observe that not connectors are switched!

c) Prepare the control for operation and re-establish the original state (see sections 21.2.4 to 21.2.5)!

Exchange is now finished.

22. Machine Parameter List

Safety Precautions

General Remarks

The service manual TNC 370 can be used to diagnose, locate and eliminate errors on machine tools controlled by TNC.

In order to correctly judge the problems in an NC-controlled machine tool, fundamental knowledge of the machine tool and its drives, as well as their interaction with the control and the measuring systems is required.

HEIDENHAIN is not liable for any damage or personal injury caused directly or indirectly or by improper use or incorrect operation.

Power Connection

Damage and personal injury may result, if the grounded lead is interrupted inside or outside the control, or if the grounded lead connector is disengaged. Intentional interruption is not permissible.

Inputs and Outputs of the Control

To avoid damage and personal injury, connect the inputs and outputs of the control only to circuits whose voltage is generated according to VDE 0100/5.73 § 8 (protective low voltage).

Machine Parameters / Settings

The machine parameter values and settings may only be changed by or upon consultation with the machine tool manufacturer.
Incorrect or not properly optimized values or settings may lead to incorrect behaviour of the machine tool causing damage and personal injury.

Connectors

To avoid damage and personal injury, switch off the main switch of the machine tool before engaging or disengaging any connectors.

Code Numbers

123	MACHINE PARAMETER EDITING FOR END USERS (marked by *)
75368	OFFSET ADJUSTMENT
86357	REMOVE EDIT/ERASE PROTECTION
95148	MP MODE
531210	RESET M0 TO M999 AND BYTES 0 - 127
807667	PLC MODE
951026	START RUN-IN PROGRAM FROM EPROM

Machine Parameters

The following list contains the machine parameters for all software versions.
Since however, certain machine parameters are only valid for a certain software or have been introduced with a certain software version, there are columns with symbols for differentiation after the parameter number.

Explanation of the Symbols:

◆ = The machine parameter of this control applies for all software versions.
04 = The machine parameter has been introduced with a certain software version (e.g. 04 means: introduced with software version 04).
I04 = The machine parameter is inactive.
- = The machine parameter is not available on this control.

Explanation of the Columns:

A = TNC 370 with NC software 280 60* –
B = reserved

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Axes with encoder		10				0 = without encoder	15
	X		0	◆		+1 = X axis with encoder	
	Y		1	◆		+2 = Y " " "	
	Z		2	◆		+4 = Z " " "	
	IV		3	◆		+8 = IV. " " "	
Encoder-monitoring:		30				0 = no axis monitored	15
Absolute position with distance-coded	X		0	◆		+1 = X axis monitored	
reference marks	Y		1	◆		+2 = Y " "	
	Z		2	◆		+4 = Z " "	
	IV		3	◆		+8 = IV. " "	
Encoder signal		31				0 = no axis monitored	31
Amplitude	X		0	◆		+1 = X axis monitored	
	Y		1	◆		+2 = Y " "	
	Z		2	◆		+4 = Z " "	
	IV		3	◆		+8 = IV. - " "	
	S		4	◆		+16 = S " "	
Encoder signal		32				0 = no axis monitored	31
Frequency	X		0	◆		+1 = X axis monitored	
	Y		1	◆		+2 = Y " "	
	Z		2	◆		+4 = Z " "	
	IV		3	◆		+8 = IV. " "	
	S		4	◆		+16 =S " "	

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Screen display	40				0 = no axis displayed	15
X		0	◆		+1 = X axis displayed	
Y		1	◆		+2 = Y " "	
Z		2	◆		+4 = Z " "	
IV		3	◆		+8 = IV. " "	
Controlled axes	50				0 = no axis controlled	15
X		0	◆		+1 = X axis controlled	
Y		1	◆		+2 = Y " "	
Z		2	◆		+4 = Z " "	
IV		3	◆		+8 = IV. " "	
Allocation of the encoder inputs to the axes					0 .. 5	
X	110.0		◆		0 = X1	0
Y	110.1		◆		1 = X2	1
Z	110.2		◆		2 = X3	2
IV	110.3		◆		3 = X4	3
					4 = no function	
					5 = X6[1]	
Allocation of the analogue outputs (multiple allocation possible when operating with central drive)					0 ... 5	
X	120.0		◆		0 = output 1	0
Y	120.1		◆		1 = " 2	1
Z	120.2		◆		2 = " 3	2
IV	120.3		◆		3 = " 4	3
					4 = no function	
					5 = " S[2]	

[1] X6 may only be used for a machine axis, if no spindle orientation is required.
[2] S-analogue may only be used for a machine axis, if no analogue output of the spindle speed is required.

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Counting direction of the encoders		210				0 = positive	0
	X		0	◆		+1 = X axis negative	
	Y		1	◆		+2 = Y " "	
	Z		2	◆		+4 = Z " "	
	IV		3	◆		+8 = IV. " "	
Encoder evaluation	X	310.0		I07		0 ... 3	0
	Y	310.1		I07		0 = 256-fold	0
	Z	310.2		I07		1 = 4-fold	0
	IV	310.3		I07		2 = 2-fold	0
						3 = 1-fold	
Signal period							
(displacement per grating period.	X	330.0		◆		1 ... 100 [µm] or $\frac{1}{1000}$ [°]	20
The screw pitch must be considered when	Y	330.1		◆			20
using a rotary encoder.)	Z	330.2		◆			20
With square-wave input signals the	IV	330.3		◆			20
displacement must be entered per square-wave period. (Consider external interpolation)							
External evaluation	X	340.0		◆		0 ... 5	0
(for connection of a square-wave encoder	Y	340.1		◆		0 = no EXE	0
with distance-coded reference marks to	Z	340.2		◆		1 = 1-fold-EXE	0
the encoder input X6)	IV	340.3		◆		2 ... 4 = reserved	0
						5 = 5-fold-EXE	0
Line count of the spindle encoder	S	340.4		07		0 = 1024 pulses	0
at encoder input X6						2 = 2048 pulses	
						4 = 4094 pulses	
						1, 3, 5 = reserved	
Axis designation	IV	410.3		◆		0 = A 1 = B 2 = C	2
						3 = U 4 = V 5 = W	

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Backlash compensation	X	710.0		◆		- 1.000 ... + 1.000 [mm].	0
	Y	710.1		◆			0
	Z	710.2		◆			0
	IV	710.3		◆			0
Compensation of reversal spikes with circular movements							
Magnitude of reversal spike	X	711.0		◆		0 ... 1 [mm]	0
	Y	711.1		◆		(0 = inactive)	0
	Z	711.2		◆			0
	IV	711.3		◆			0
Speed to compensate the reversal spike	X	712.0		◆		0 ... 10 [mm per CLP cycle time]	0
	Y	712.1		◆		(0 = inactive)	0
	Z	712.2		◆			0
	IV	712.3		◆			0
Factor for linear axis error compensation	X	720.0		◆		-1.000 ... +1.000 [mm/m]	0
	Y	720.1		◆			0
	Z	720.2		◆			0
	IV	720.3		◆			0
Multipoint axis error compensation		730				0 = linear compensation active	0
	X		0	◆		+1 = multipoint compensation active X axis	
	Y		1	◆		+2 = multipoint compensation active Y axis	
	Z		2	◆		+4 = multipoint compensation active Z axis	
	IV		3	◆		+8 = multipoint compensation active IV. axis	

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Software limit switches							
Range1	X+	910.0		•		linear axis:	+ 99 999.999
Default setting after	Y+	910.1		•		-99 999.999 ... +99 999.999[mm]	▪
power-on;	Z+	910.2		•		rotary axis:	▪
activation via PLC:	IV	910.3		•		-99 999.999 ... +99 999.999[°]	▪
M2817 = 0, M2816-0;	+	920.0		•			- 99 999.999
strobe marker M2824	X-	920.1		•			▪
	Y-	920.2		•			▪
	Z-	920.3		•			▪
	IV-						
Range 2		911.0		•			+ 99 999.999
Activation via PLC	X+	911.1		•			▪
M2817-0, M2816-1;	Y+	911.2		•			▪
strobe marker M2824	Z+	911.3		•			▪
	IV	921.0		•			- 99 999.999
	+	921.1		•			▪
	X-	921.2		•			▪
	Y-	921.3		•			▪
	Z-						
	IV-						
Range 3	X+	912.0		•			+ 99 999.999
Activation via PLC	Y+	912.1		•			▪
M2817-1, M2816=0;	Z+	912.2		•			▪
strobe marker M2824	IV	912.3		•			▪
	+	922.0		•			- 99 999.999
	X-	922.1		•			▪
	Y-	922.2		•			▪
	Z-	922.3		•			▪
	IV-						

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Datum for positioning blocks with M92: (referenced to the machine datum)	X	950.0		•		linear axis:	0
	Y	950.1		•		-99 999.999 ... +99 999.999[mm]	0
	Z	950.2		•		rotary axis:	0
	IV	950.3		•		-99 999.999 ... +99 999.999[°]	0
Rapid traverse	X	1010.0		•		linear axis:	10000
	Y	1010.1		•		80 ... 300 000 [mm/min]	"
	Z	1010.2		•		rotary axis:	"
	IV	1010.3		•		80 ... 300 000 [°/min]	"
Manual feed	X	1020.0		•		linear axis:	10000
	Y	1020.1		•		80 ... 30 000 [mm/min]	"
	Z	1020.2		•		rotary axis:	"
	IV	1020.3		•		80 ... 300 000 [°/min]	"
Positioning window	X	1030.0		•		linear axis:	0.025
	Y	1030.1		•		0.001 ... 2.000 [mm][1]	"
	Z	1030.2		•		rotary axis:	"
	IV	1030.3		•		0.001 ... 2.000 [°]	"
Polarity of the nominal voltage with positive direction of traverse		1040		•		0 = positive	0
	X		0			+1 = X axis negative	
	Y		1			+2 = Y " "	
	Z		2			+4 = Z " "	
	IV		3			+8 = IV. " "	
Analogue voltage for rapid traverse		1050		•		4.5 ... 9 [V]	9
	X	1050.0		•			9
	Y	1050.1		•			9
	Z	1050.2		•			9
	IV	1050.3		•			9

[1] adapted to MP 7290 (display step)

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Acceleration	X	1060.0		◆		0.001 ... 3.0 [m/s²]	0.5
	Y	1060.1		◆			0.5
	Z	1060.2		◆			0.5
	IV	1060.3		◆			0.5
Radial acceleration		1070		◆		0.001 ... 3.0 [m/s²]	1
Integral factor	X	1080.0		◆		0 ... 65 535	0
	Y	1080.1		◆			0
	Z	1080.2		◆			0
	IV	1080.3		◆			0
Standstill monitoring		1110		◆		0.001 ... 30 [mm] [1]	0.5
Movement monitoring		1140		◆		0.03 ... 10 [V]	1
Time out for switching off the nominal voltage when the error message 'Positioning Error' is displayed		1150		◆		0 ... 65 535 [s]	0
Automatic, cyclic offset adjustment		1220		◆		1 ... 65 535 [s] 0 = no automatic adjustment	0

[1] adapted to MP 7290 (display step)

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Reference mark evaluation		1320				0 = positive	0
Direction for traversing the reference	X		0	◆		+1 = X axis negative	
marks	Y		1	◆		+2 = Y " "	
	Z		2	◆		+4 = " "	
	IV		3	◆		+8 = IV. " "	
Feed rate for traversing the reference	X	1330.0		◆		linear axis:	10000
marks	Y	1330.1		◆		80 ... 30000 [mm/min]	"
	Z	1330.2		◆			"
	IV	1330.3		◆		rotary axis:	"
						80 ... 30000 [°]	
Feed rate for leaving the reference	X	1331.0		◆		linear axis:	500
end position (only for	Y	1331.1		◆		80 ... 500 [mm/min]	"
rotary encoders, MP 1350 = 2)	Z	1331.2		◆			"
	IV	1331.3		◆		rotary axis:	"
						80 ... 500 [°/min]	
Axis sequence for approaching						0 = no ref. mark traverse	
the ref. marks	1. axis	1340.0		◆		1 = X	1
	2. axis	1340.1		◆		2 = Y	2
	3. axis	1340.2		◆		3 = Z	3
	4. axis	1340.3		◆		4 = IV	4
Selecting the functional procedure for	X	1350.0		◆		0 = linear encoder with distance-	1
traversing the reference marks	Y	1350.1		◆		coded reference marks	1
	Z	1350.2		◆		1 = linear encoder without distance-	1
	IV	1350.3		◆		coded reference marks	1
						2 = special operation (linear measurement with rotary encoder)	

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Operation with feed forward control or trailing mode	1390		•		0 = feed forward control 1 = trailing mode	0

Operation with Feed Forward Control

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Servo lag monitoring when operating with feed forward control							0.5
erasable (POSITIONING ERROR)		1410		•		0.001 ... 30.000 [mm]	
EMERG. STOP (GROSS POSITIONING ERROR A)		1420		•		0.001 ... 30.000[mm]	1
Kv-Factor for operation with feed forward control	X	1510.0		•		0.1 ... 10	2
	Y	1510.1		•			2
	Z	1510.2		•			2
	IV	1510.3		•			2
Approach speed		1520		•		0.1 ... 10 [m/min]	2

1) adapted to MP 7290 (display step)

Cams for "Reference End Position":

The reference marks can either be traversed manually using the axis directional keys or automatically with the start key. It is not necessary to enter a code number for the manual traverse as was the case with preceding TNC contouring controls. The traverse direction for the automatic traverse of the reference marks is set in the MP1320. In order to invert the predetermined traverse direction, a cam for "reference end position" is required. The triggering signals for the "reference end position" are assigned to free PLC inputs. These PLC inputs are connected to the PLC markers M2506 and M2556 to M2559 via the PLC software.

Linear Encoder with Distance-Coded Reference Marks (MP1350.X = 0)

If the triggering signal "reference end position" is set when starting ref. mark traverse, the axis traverses in the direction opposite to that set in teh MP1320. If the triggering signal "reference end position" is only set during automatic traverse, the TNC ingores this signal. Thus, there must be at least 2 reference marks within the range of the "reference end position". Reference mark evaluation takes place either in the range of the "reference end position" or else beyond this range. In the case of an evaluation beyond the "software limit switch" range, the axis traverses automatically to the software limit switch after evaluation.

Linear Encoder without Distance-Coded Reference Marks (MP1350 = 1):

The traverse direction is automatically reversed, if the axis traverses the cam for "reference end position" during automatic traverse. If the axis is already in the range of the "reference end position" when starting, the axis immediately traverses in the opposite direction. For this reason the reference mark may not be within the "reference end position" range.

Special Operation: Linear Measurement with a Rotary Encoder (MP1350.X = 2):

The axis traverses automatically to the cam for "reference end position" with the predetermined feed rate (MP1330). The axis is started with reduced feed rate (MP1331) in the opposite direction; the first reference mark is evaluated after the end of the "reference end position" range has been reached. Then the axis is stopped. If the axis is already in the "ref. end position" range when starting, it traverses immediately with the reduced feed rate (MP1331) in the direction opposite to that indicated in MP1320.

Operation with Servo Lag

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Servo lag monitoring in the trailing mode erasable (POSITIONING ERROR)		1710		◆		0 ... 1000.000 [mm]	20
EMERG. STOP (GROSS POSITIONING ERROR A)		1720		◆		0 ... 1000.000 [mm]	30
Kv-Factor for the trailing mode	X	1810.0		◆		0.1 ... 10	2
	Y	1810.1		◆			2
	Z	1810.2		◆			2
	IV	1810.3		◆			2
Multiplication factor for the Kv-factor		1820		◆		0.001 ... 1.000	1
Position of characteristic kink		1830		◆		0 ... 100.000 [%]	100

Spindle Control

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Output of spindle speed	3010		•		0 = no output of spindle speed	6
Coded					1 = BCD-coded output of spindle speed only if speed changes. 2 = BCD-coded output of spindle speed with every TOOL CALL	
Analogue					3 = analogue output of spindle speed; gear switching signal only if gear range changes. 4 = analogue output of spindle speed; gear switching signal with every TOOL CALL 5 = analogue output of spindle speed; no gear switching signal	
Controlled spindle for orientation					6 = as entry value 3, but with controlled spindle for orientation 7 = as entry value 4, but with controlled spindle for orientation 8 = as entry value 5, but with controlled spindle for orientation	
Limitation of speed code	3020		•		0 ... 99999 01991 = no limitation	00991
Axis standstill, if only an new spindle speed is output during a TOOL CALL	3030		•		0 = axis standstill 1 = no axis standstill	0
Programmed shaft speed **S = 0** (if MP 3240.1 is not 0)	3120		•		0 = 0 rpm permitted 1 = 0 rpm not permitted	0

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Polarity of S-analogue voltage	3130		◆		0 = M03: positive voltage M04: negative voltage 1 = M03: negative voltage M04: positive voltage 2 = M03 + M04: pos. voltage 3 = M03 + M04: neg. voltage	0
Counting direction of spindle	3140		◆		0 = positive 1 = negative	0
Analogue voltage for gear ranges 0	3210.0		◆		0 ... 9.999 [V]	9.999
1	3210.1		◆			9.999
2	3210.2		◆			9.999
3	3210.3		◆			9.999
4	3210.4		◆			9.999
5	3210.5		◆			9.999
6	3210.6		◆			9.999
7	3210.7		◆			9.999
Controlled range for S-analogue output Maximum output voltage for S-analogue output	3240.0		◆		0 ... 9.999 [V]	9.999
Minimum output voltage for S-analogue output	3240.1		◆		0 ... 9.999 [V]	0
Nominal voltage for spindle drive when switching the gear (direction of rotation: markers 2490 and 2491)	3240.2		◆		0 ... 9.999 [V]	2

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Limitation of S-Override				◆			
Max		3310.0				0 ... 150 [%]	150
Min		3310.1		◆			0
S-analogue ramp gradient for:							
spindle ON/OFF ,M03, M04, M05		3410.0		◆		0 ... 1.999 [V/ms]	0.1
spindle orientation		3410.1		◆		0 ... 1.999 [V/ms]	0.1
"TAPPING" cycle		3410.2		◆		0 ... 1.999 [V/ms]	0.1
"RIGID TAPPING" cycle		3410.3		◆		0 ... 1.999 [V/ms]	0.1
Positioning window for spindle		3420		◆		0 ... 65 535 increments	10
Spindle preset		3430		◆		0 ... 360 [°]	0
Kv-Factor for spindle	0	3440.0		◆		0.1 ... 10	2
per gear range	1	3440.1		◆			2
	2	3440.2		◆			2
	3	3440.3		◆			2
	4	3440.4		◆			2
	5	3440.5		◆			2
	6	3440.6		◆			2
	7	3440.7		◆			2
S-analogue output	0	3510.0		◆		0 ... 99 999.999 [rpm]	1000
speed range for the gear ranges	1	3510.1		◆			2000
	2	3510.2		◆			3000
	3	3510.3		◆			4000
	4	3510.4		◆			5000
	5	3510.5		◆			6000
	6	3510.6		◆			7000
	7	3510.7		◆			8000
Spindle speed							
if marker 2501 is set		3520.0		◆		0 ... 99 999.999 [rpm]	0
for spindle orientation		3520.1		◆		0 ... 99 999.999 [rpm]	10

Integral PLC

Function	MP No. Bit	A	B	Input	AE-6 Entry Value
PLC Program from RAM or from EPROM	4010	◆		+ 0 = EPROM +1 = RAM	0
Automatic lubrication X	4060.0	◆		0 ... 65 535 [PLC cycle times]	0
Y	4060.1	◆			0
Z	4060.2	◆			0
IV	4060.3	◆			0
PLC: Time	4110.0	◆		0 ... 65 535 [PLC cycle times]	100
for timers 0 - 26	4110.1	◆			22
	4110.2	◆			50
	4110.3	◆			100
	4110.4	◆			4
	4110.5	◆			5
	4110.6	◆			6
	4110.7	◆			7
	4110.8	◆			8
	4110.9	◆			9
	4110.10	◆			10
	4110.11	◆			11
	4110.12	◆			12
	4110.13	◆			13
	4110.14	◆			14
	4110.15	◆			15
	4110.16	◆			25
	4110.17	◆			0
	4110.18	◆			0
	4110.19	◆			0
	4110.20	◆			0
	4110.21	◆			0
	4110.23	◆			0
	4110.24	◆			0
	4110.25	◆			0
	4110.26	◆			0

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
PLC: Time for timers 27 - 47	4110.27		◆		0 ... 65 535 [PLC cycle times]	0
	4110.28		◆			0
	4110.29		◆			0
	4110.30		◆			0
	4110.31		◆			0
	4110.32		◆			0
	4110.33		◆			0
	4110.34		◆			0
	4110.35		◆			0
	4110.36		◆			0
	4110.37		◆			0
	4110:38		◆			0
	4110.39		◆			0
	4110.40		◆			0
	4110.41		◆			0
	4110.42		◆			0
	4110.43		◆			0
	4110.44		◆			0
	4110.45		◆			0
	4110.46		◆			0
	4110.47		◆			0
PLC: preset counter values for counters 0 - 10	4120.0		◆		0 ... 65 535 [PLC cycle times]	0
	4120.1		◆			1
	4120.2		◆			2
	4120.3		◆			3
	4120.4		◆			4
	4120.5		◆			5
	4120.6		◆			6
	4120.7		◆			7
	4120.8		◆			8
	4120.9		◆			9
	4120.10		◆			10

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
PLC: preset counter values for counters 11 - 31	4120.11		◆		0 ... 65 535 [PLC cycle times]	11
	4120.12		◆			12
	4120.13		◆			13
	4120.14		◆			14
	4120.15		◆			15
	4120.16		◆			16
	4120.17		◆			17
	4120.18		◆			18
	4120.19		◆			19
	4120.20		◆			20
	4120.21		◆			21
	4120.22		◆			22
	4120.23		◆			23
	4120.24		◆			24
	4120.25		◆			25
	4120.26		◆			26
	4120.27		◆			27
	4120.28		◆			28
	4120.29		◆			29
	4120.30		◆			30
	4120.31		◆			31
Fast PLC input defining the fast input	4130		◆		0 ... 254	0
defining the active level	4131		◆		0 = 0V active 1 = 24V active	0

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
PLC: 36 position values for PLC positioning	4210.0		◆		-99 999.999 ... +99 999.999[mm] or [°]	+10
	4210.1		◆			+1
	4210.2		◆			+2
	4210.3		◆			+3
	4210.4		◆			+4
	4210.5		◆			+5
	4210.6		◆			+6
	4210.7		◆			+7
	4210.8		◆			+8
	4210.9		◆			+9
	4210.10		◆			+10
	4210.11		◆			+11
	4210.12		◆			+12
	4210.13		◆			+13
	4210.14		◆			+14
	4210.15		◆			+15
	4210.16		◆			+16
	4210.17		◆			+17
	4210.18		◆			+18
	4210.19		◆			+19
	4210.20		◆			+20
	4210.21		◆			+21
	4210.22		◆			+22
	4210.23		◆			+23
	4210.24		◆			+24
	4210.25		◆			+25
	4210.26		◆			+26
	4210.27		◆			+27
	4210.28		◆			+28
	4210.29		◆			+29
	4210.30		◆			+30
	4210.31		◆			+31

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
PLC: position values for PLC positioning	4210.32					0
	4210.33					0
	4210.34					0
	4210.35					0
	4210.36					0
	4210.37					0
	4210.38					0
	4210.39					0
	4210.40					0
	4210.41					0
	4210.42					0
	4210.43					0
	4210.44					0
	4210.45					0
	4210.46					0
	4210.47					0
Setting a value in the PLC						
W 960	4220.0		◆		0 ... 65 535	5000
W 962	4220.1		◆			5000
W 964	4220.2		◆		e.g. feed rate for PLC positionings	5000
W 966	4220.3		◆			5000
W 976	4310.0		◆		0 ... 65 535	20480
W 978	4310.1		◆			0
W 980	4310.2		◆			0
W 982	4310.3		◆			0
W 984	4310.4		◆			0
W 986	4310.5		◆			0
W 988	4310.6					0

Adaptation of the Data Interface

Function	MP No. Bit	A	B	Input	AE-6 Entry Value
1. Control character for end of program (ETX) 2. Control character for start of program (STX)	5010.0*	◆	◆	0 ... 32 382	515
1. ASCII character for file type during data input 2. ASCII character for input code (E)	5010.1*	◆	◆	0 ... 32 382	17736
1. ASCII character for file type during data output 2. ASCII character for output code (A)	5010.2*	◆	◆	0 ... 32 382	16712
1. Control character for end of command block (ETB) 2. Control character for start of command block (SOH)	5010.3*	◆	◆	0 ... 32 382	279
1. Control character for positive-acknowledgement (ACK) 2. Control character for negative acknowledgement (NAK)	5010.4*	◆		0 ... 32 382	0
Control character for end of transfer (EOT)	5010.5*	◆		0 ... 32 282	0

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Data format and transfer stop for RS-232-C/EXT data interface	5020*		•		0 ... 255	168
7 or 8 data bits		0			+ 0 = 7 data bit 8 = parity + 1 = 8 data bit 8 = 0 and bit 9 = parity	
Block check character		1			+ 0 = BCC is also control character + 2 = BCC is not control character	
Transfer stop by RTS		2			+ 0 = inactive + 4 = active	
Transfer stop by DC3		3			+ 0 = inactive + 8 = active	
Even / odd parity		4			+ 0 = even + 16 = odd	
Parity on / off		5			+ 0 = off + 32 = on	
Number of stop bits		6/7			+ 64 => bit 6 = 1 + 120 => bit 7 = 1 7 | 6 0 | 0 = 1 1/2 stop bits 0 | 1 = 2 stop bits 1 | 0 = 1 stop bit 1 | 1 = 1 stop bit	
Activating the RTS signal		8	06		+0 = RTS signal always active +256 = RTS signal is only activated together with data transfer and inactivated when the transfer is finished.	
		9	07		+0 = EOT is transmitted after ETX was received +1024= EOT is **not** transmitted after ETX was received	
Operating mode for EXT	5030*		•		0 = "standard data interface" 1 = "blockwise transfer"	0

* accessible via code number 123

Operation with 3D Touch Probe

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Selecting the touch probe	6010*		◆		0 = transmission via cable 1 = infrared transmission	0
Number of probing operations	6100		◆		0.1 = one probing operation 2 - 5 = number of probing operations	0
Touch probe						
Feed rate for probing	6120*		◆		80 ... 30 000 [mm/min]	1000
Probing range	6130*		◆		0.001 ... 30 000.000 [mm]	20
Safety clearance above probing point for automatic probing	6140*		◆		0.001 ... 30 000.000 [mm]	20
Rapid feed for probing	6150*		◆		80 ... 30 000 [mm/min]	2000

Digitizing with 3D Touch Probe

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Oscillations in normal direction	6210		◆		0 ... 65 535 [s]	3
Feed in normal direction	6230		◆		0 ... 1000 [mm/min]	30
Deflection range of stylus	6240		◆		0 ... 10 [mm]	5
Modal M86	6250		I07		0 = no transfer 1 ... 89 number of M-function	33
Output of M90	6260		◆		0 = no, 1 = yes	0
Output value rounded	6270		◆		0 = 1 µm, 1 = 10 µm	0

* accessible via code number 123

Tool Calibration with TT

Function	MP No. Bit	A	B	Input	AE-6 Entry Value
Tool calibration cycles	6500	07		0 = cycles disabled 1 = cycles enabled	0
Probing direction for tool calibration	6505*	07		0 = pos. probing direction in the angle reference axis (0° axis) 1 = pos. probing direction in the +90° axis 2 = neg. probing direction in the angle reference axis (0° axis) 3 = neg. probing direction in the +90° axis	0
Calculation of the probing feed rate	6507*	07		0 = calculation of probing feed rate with constant tolerance 1 = calculation of probing feed rate with variable tolerance 2 = constant probing feed rate 3 = constant spindle speed	0
Maximum permissible measuring error for measurement with a rotating tool	6510*	07		0.002 to 0.999 [mm]	0.005
Probing feed rate for measurement with a non-rotating tool	6520*	07		10 to 3 000 [mm/min]	10
Distance between lower edge of tool and upper edge of stylus for tool radius measurement	6530*	07		0.001 to 99.999 [mm]	10
Diameter or edge length of the TT 110 stylus	6531*	07		0.001 to 99 999.999 [mm]	10

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Safety zone around the stylus of TT 110 for pre-positioning	6540*		07		0.001 to 99 999.999 [mm]	10
Rapid traverse in the probing cycle for TT	6550*		07		10 to 10 000 [m/min]	10
M function for oriented spindle stop for measuring individual cutting edges	6560*		07		-1 = oriented spindle stop by NC 0 = function inactive +1 to 88 = number of M function for oriented spindle stop via PLC	10
Maximum permissible surface cutting speed at the cutting edges of the tool	6570*		07		1.0000 to 120 [m/min]	100
Center coordinates of the TT 110 stylus referenced to the machine datum					-99 999.999 to +99 999.999 [mm]	
X	6580.0*		07			0
Y	6580.1*		07			0
Z	6580.2*		07			0

* accessible via code number 123

Miscellaneous

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Automatic confirmation of the error message "Power Interrupted"	7000		107		0 = error message "Power Interrupted" must be confirmed manually 1 = error message "Power Interrupted" is confirmed automatically after approximately 3 seconds	0

Tapping

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Feed Override						
Minimum	7110.0		◆		0 ... 150 [%]	95
Maximum	7110.1		◆		0 ... 150 [%]	105
Dwell time to invert the direction of rotation of the ballscrew in a TAPPING cycle	7120.0		◆		0 ... 65 535 [s]	0
Deceleration time of the spindle in a TAPPING cycle (only active with BCD output of the spindle speed)	7120.1		◆		0 ... 65 535 [s]	0
Spindle slow-down time after the boring depth has been reached	7120.2		◆		0 ... 65 535 [s]	0
Run-in behaviour of the spindle in a RIGID TAPPING cycle	7130		◆		0.1 ... 10 [m/min]	2
Transient response of the spindle during acceleration in a RIGID TAPPING cycle	7140		◆		0.01 ... 0.999	0.25
Positioning window of tool axis	7150		◆		0.01 ... 2.0 [µm]	0.05

Function	MP No. Bit	A	B	Input	AE-6 Entry Value
Oriented spindle stop at the beginning of cycle 17 "RIGID TAPPING"	7160	◆		0 = oriented spindle stop active 1 = oriented spindle stop inactive	0
Programming station	7210*	◆		0 = control 1 = programming station: PLC active 2 = programming station: PLC inactive	0
Automatic confirmation of the error message "Power Interrupted"	7212	07		0 = "power interrupted" must be confirmed by hand 1 = " power interrupted" is confirmed automatically after approx. 3 seconds	0
Step width of block numbers (for ISO programming)	7220*	◆		0 ... 255	1
Selecting the programming language	7222	◆		0 = HEIDENHAIN and ISO programming 1 = HEIDENHAIN conversational programming only 2 = ISO programming only	0
Switching over the dialog language	7230	◆		0 = 1. dialog language 1 = 2. dialog language	0

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Resetting the software clocks, that can be called with the code number 857 282	7235	0	◆		+ 0 = no reset + 1 = reset TNC run time	0
		1	◆		+ 0 = no reset + 2 = reset program run time	
		2	◆		+ 0 = no reset + 4 = reset spindle run time	
Inhibiting PGM input if PGM No. = number of OEM cycle	7240*		I07		0 = inhibited 1 = not inhibited	1
Inhibiting HEIDENHAIN cycles cycles 0 ... 15	7245.0		I07		0 ... 65 535 0 = no cycle inhibited + 2 (bit 1) = cycle 1 inhibited + 4 (bit 2) = cycle 2 inhibited etc.	0
cycles 16 ... 31	7245.1		I07		0 ... 65 535 0 = no cycle inhibited + 1 (bit 0) = cycle 16 inhibited + 2 (bit 1) = cycle 17 inhibited	0
Difference between Q-parameter numbers for "DLG-DEF" and "DLG-Call blocks in OEM cycles	7250		I07		0 ... 50 0 if "DLG-CALL" blocks only	0
Number of global Q-Parameters that are transferred from an OEM cycle to the calling program.	7251		◆		0 ... 40 If the value is 40 the Q-parameters Q60 ... Q99 are global	0
Central tool file	7260*		◆		0 = no central tool file 1 ... 99 = central tool file entry value = number of tools	0

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Number of pockets in tool changer	7261*		•		0 ... 254	10
Number of reserved pockets next to special tool	7264*		107		0 ... 3	0
Items in the tool table (.T file) that can be displayed and output via interface:					0 = not displayed 1 - 99 = position of the element in the tool table	
NAME (tool name)	7266.0		07			1
L (tool length)	7266.1		07		smallest value = first position	2
R (tool radius 1)	7266.2		07		highest value = last position	3
R2 (tool radius 2)	7266.3		07			0
DL (oversize tool length)	7266.4		07			4
DR (oversize tool radius 1)	7266.5		07			5
DR2 (oversize tool radius 2)	7266.6		07			0
TL (tool locked)	7266.7		07			6
RT (replacement tool)	7266.8		07			7
TIME1 (max. tool life)	7266.9		07			8
TIME2 (max. tool life with TOOL CALL)	7266.10		07			9
CUR.TIME current tool life)	7266.11		07			10
DOC (commentary on tool)	7266.12		07			11
CUT (number of cutting edges)	7266.13		07			12
LTOL (tolerance for tool length)	7266.14		07			13
RTOL (tolerance for tool radius)	7266.15		07			14
DIRECT (cutting direction of the tool)	7266.16		07			15
PLC (PLC status)	7266.17		07			16
TT: L-OFFS (tool offset, length)	7266.18		07			17
TT: R-OFFS (tool offset, radius)	7266.19		07			18
LBREAK (breakage tolerance, tool length)	7266.20		07			19
RBREAK (breakage tolerance, tool radius)	7266.21		07			20

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Items in the pocket table (TOOL.P file)					0 = not displayed 1 - 99 = position of the element in the tool table	
T (tool number)	7267.0		07			1
ST (special tool)	7267.1		07		smallest value = first position	2
F (fixed pocket)	7267.2		07		highest value = last position	3
L (locked pocket)	7267.3		07			4
PLC (PLC status)	7267.4		07			5
Display of current feed rate in the manual operating modes (manual operation, handwheel)	7270*		◆		0 = display of axis feed rate only when an axis direction key is pressed (feed from MP1020.X individually for each axis) 1 = display of axis feed rate also before an axis direction key is pressed (smallest value from MP1020.X for all axes)	1
Expanded spindle display	7274					
display of the current gear range		0	◆		+ 0 = no display + 1 = display after "/"	0
acquisition of the spindle performance		1	◆		+ 0 = acquisition via analogue input NOTE: maximum value 4.999 V + 2 = acquisition via PLC word W600	0
Reference value for display of spindle performance 100 %	7275		◆		MP 7274 bit 1 = 0 ⇒ 0 ... 43 960 [mV] MP 7274 bit 1 = 1 ⇒ 0 ... 43 960	0
Decimal character	7280*		◆		0 = decimal comma 1 = decimal point	0
Tool length in nominal/actual display	7285*		◆		0 = ignored 1 = taken into account	0

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Display step	7290*		•		0 = 1 µm 1 = 5 µm 2 = 10 µm 3 = 50 µm 4 = 100 µm	0
Selective erasing of - status data (S) - TOOL data (T) - Q-parameter contents (Q) with M02, M30	7300*	0 1 2	•		0 ... 7 [1] - = data are erased	0
Graphics (display mode) Switching the "View in 3 Planes" Rotating the coordinate system by 90° in the working plane	7310*	0 1	•		+0 = German standard +1 = American standard +0 = no rotation +2 = coordinate system rotated by 90°	0

	end of program	program selection
0 =	S Q T	- - -
1 =	- - -	- - -
2 =	S Q T	- Q -
3 =	- Q -	- Q -
4 =	S Q T	- - T
5 =	- - T	- - T
6 =	S Q T	- Q T
7 =	- Q T	- Q T

* accessible via code number 123

1) if the entry value is ≥ **4** the (programmed) tool inserted last is activated automatically when the control is switched on.

Function		MP No.	Bit	A	B	Input	AE-6 Entry Value
Defining the user parameters (call via MOD function)	0	7330.0		◆		0 ... 9 999.99 number of desired machine parameter	0
	1	7330.1		◆			0
	2	7330.2		◆			0
	3	7330.3		◆			0
	4	7330.4		◆			0
	5	7330.5		◆			0
	6	7330.6		◆			0
	7	7330.7		◆			0
	8	7330.8		◆			0
	9	7330.9		◆			0
	10	7330.10		◆			0
	11	7330.11		◆			0
	12	7330.12		◆			0
	13	7330.13		◆			0
	14	7330.14		◆			0
	15	7330.15					0
Defining the dialogs for the user parameters (call via MOD function)	0	7340.0		◆		0 ... 99 dialog from PLC error range 100 ... 199 dialog from PLC dialog range	199
	1	7340.1		◆			198
	2	7340.2		◆			197
	3	7340.3		◆			196
	4	7340.4		◆			195
	5	7340.5		◆			194
	6	7340.6		◆			193
	7	7340.7		◆			192
	8	7340.8		◆			191
	9	7340.9		◆			190
	10	7340.10		◆			189
	11	7340.11		◆			188
	12	7340.12		◆			187
	13	7340.13		◆			186
	14	7340.14		◆			185
	15	7340.15					184

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Cycle "Scaling Factor" acts upon 2 or 3 axes	7410*		•		0 = 3 axes 1 = in the operating plane	0
Tool data in TOUCH-PROBE block	7411		•		0 = the current tool data are overwritten by the calibrated touch probe data 1 = the current tool data remain stored	1
Cycle for milling pockets of any contour	7420*		•			0
"Clear out" cycle: direction for pilot milling of the contour		0			+ 0 = pilot milling of the contour: ccw with pockets cw with islands + 1 = pilot milling of the contour: cw with pockets ccw with islands	
"Clear out" cycle: sequence for pilot milling and clearing out		1			+ 0 = mill a channel round the contour first, then clear out the pocket + 2 = clear out the pocket first, then mill a channel round the contour	
combining compensated or non-compensated contours		2			+ 0 = combine corrected contours + 4 = combine uncorrected contours	
"Clearing out" and "Pilot milling" until the pocket depth is reached or for each infeed		3			+ 0 = "Roughing out" / "Pilot milling occurs over all infeeds + 8 = with every infeed, "Pilot milling" is run before "Roughing out" (depending on bit 1)	

* accessible via code number 123

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Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Overlapping factor for pocket milling	7430*		•		0.1 ... 1.414	1.3
Output of M-functions programmed stop at M06	7440*	0	•		+ 0 = program is stopped at M06 + 1 = program is not stopped at M06	0
modal cycle call M89		1			+ 0 = standard code transfer of M89 at beginning of block + 2 = **modal** cycle call at end of block	
Program stop when an M-function is output Exceptions: axis standstill with all M-functions that result in a programmed stop (e.g. M00, M02 ...) or with STOP or a CYCL CALL block.		2			+ 0 = program stopped until the M-function is confirmed + 4 = program is not stopped (control does not wait for confirmation)	
Constant contour speed in corners	7460*		•		0 ... 179.999 [°]	10

* accessible via code number 123

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Display mode and software limit switches for rotary axis	7470*					0
Display mode		0	•		+ 0 = 0 ... +/- 359.999° (software limit switches are not monitored + 1 = 0 ... +/- 30 000.000° (software limit switches are monitored)	
Approaching the target position		1	I07		+ 0 = depending on the sign + 2 = - absolute programmed movements are positioned following the shortest arc - incremental programmed movements by the increment	
Output of tool number or pocket number with						
TOOL CALL block	7480.0		•		0 = no output 1 = output of tool number only if tool number changes (W262) 2 = output of tool number with every TOOL CALL block (W262) 3 = output of pocket number (W262) and tool number (W264) only if tool number changes	2
TOOL DEF block	7480.1		•		0 = no output 1 = output of tool number only if tool number changes (W262) 2 = output of tool number with every TOOL CALL block (W262) 3 = output of pocket number (W262) and tool number (W264) only if tool number changes	0

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Feed rate and spindle override	7620*		•			8
- Feed rate override if rapid traverse key pressed in "Program Run".		0			+ 0 = override ineffective + 1 = override effective	
- Feed rate override in steps of 2% or 1% (if active, always 1% steps)		1			+ 0 = 2% steps + 2 = 1% steps	
- Feed rate override if rapid traverse key and external direction keys pressed in the "Manual" mode		2			+ 0 = override ineffective + 4 = override effective	
- Override in steps of 0.01% with non-linear characteristic curve		3			+ 0 = override ineffective + 8 = 0.01% steps	
Handwheel - Adaptation	7640*		•		0 = no handwheel connected 1 = HR 330 (all keys via NC) [1] 2 = HR 130, HR 330 (all keys via NC) [2] 3 = HR 330 "Rapid" key via PLC I 162 "Plus" key via PLC I 160 "Minus" key via PLC I 161 4 = HR 332, evaluation of keys and LEDs depends on MP 7645.0 5 = HRA 110, multi-axis handwheel (3 x HR 150) 6 = HR 410, evaluation of keys and LEDs depends on MP 7645.0 [3]	0

* accessible via code number 123

[1] axes can only be switched with handwheel

[2] axes can be switched with handwheel or keyboard

[3] If the HR410 does not receive any initializing parameters (MP7645.X), it automatically switches to HR332 mode (MP 7640 = 4)!

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Handwheel operation	7641		•			0
- input of interpolation factor		0			+ 0 = via keyboard + 1 = via PLC module 9036	
- handwheel enable in operating mode "PROGRAMMING AND EDITING"		1			+ 0 = not enabled + 2 = enabled	
- input of interpolation factor		2			+ 4 = via keyboard or PLC module	
- handwheel control		3			+ 0 = handwheel control only in the operating modes HANDWHEEL and PROGRAMMING/EDITING + 8 = handwheel control and evaluation of the PLC inputs and outputs by the handwheel (keys, LEDs) possible in all operating modes	

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Initializing parameters for the handwheel						
	7645.0		◆			
Allocation of 3. handwheel with axis selector switch **(MP 7640 = 5)**		0			+ 0 = position 1 (left stop) → Z axis position 2 → IV. axis position 3 → V. axis + 1 = position 1 → X axis position 2 → Y axis position 3 → V. axis position 4 → IV. axis position 5 → V. axis	0
		1			+ 2 = position 3 → Z axis position 4 → IV. axis position 5 → V. axis	
		2-7			reserved	
Evaluation of the keys and LEDs on HR 332 **(MP 7640 = 4)** HR 410 in HR 332 mode **(MP 7640 = 4)**	7645.0		◆		**HR 332** 0 = keys X, Y, Z, IV and their LEDs evaluated by NC remaining keys: PLC I 164 to I 170 remaining LEDs: PLC O 100 to O 106 1 = keys: PLC I 160 to I 171 LEDs: PLC O 96 to O 107 **HR 410** 0 = keys X, Y, Z, IV and their LEDs evaluated by NC remaining keys: PLC I 164 to I 171 remaining LEDs: PLC O 100 to O 107 1 = keys: PLC I 160 to I 171 LEDs: PLC O 96 to O 107	0
HR 410 in HR 410 mode **(MP 7640 = 6)**	7645.0		◆		0 = keys X, Y, Z, IV, actl. value transfer and their LEDs evaluated by NC remaining keys: PLC I 168 to I 175 remaining LEDs: PLC O 100 to O 111 1 = keys: PLC I 160 to I 175 LEDs: PLC O 96 to O 111	0

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Assignment of 3. handwheel via machine parameter **(MP 7640 = 5)**	7645.1		◆		0 = simulation of the 1. position of the selector switch MP 7645.0 = 0 → Z axis MP 7645.0 = 1 → X axis + 1 = X axis + 2 = Y axis + 4 = Z axis + 8 = IV. axis + 16 = V. axis	0
Defining the axis selection process **(MP 7640 = 5)**	7645.2		◆		0 = axis selection with axis selector switch according to MP 7645.0 1 = axis selection according to MP 7645.1	
reserved	7645.3 ... 7645.7		◆ ◆		no function	0
Handwheel, counting direction	7650		◆		0 = positive counting direction 1 = negative counting direction	0
Hysteresis for electronic handwheel	7660		◆		0 ... 65 535 [increments]	10
Handwheel, minimum interpolation factor	7670		◆		0 ... 10	
Handwheel interpolation factor					0 ... 10	
slow (HR 130/3xx/410)	7670.0		07			0
medium (HR 410 only)	7670.1		07			0
fast (HR 410 only)	7670.2		07			0
%-factor of the HR410 feed rate					0 to 100 [%]	
slow (HR 410 only)	7671.0		07			50
medium (HR 410 only)	7671.1		07			75
fast (HR 410 only)	7671.2		07			100

Function	MP No.	Bit	A	B	Input	AE-6 Entry Value
Memory function for directional keys	7680		◆		0 = no storage + 1 = storage	1
Memory test after power-on	7690					3
RAM test		0	◆		+ 0 = test + 1 = no test	
EPROM test		1	◆		+ 0 = test + 2 = no test	